19-287

Judge Deady

TRANSCRIPT OF RECORD.

SUPREME COURT OF THE UNITED STATES.

No. 340.

ROLAND G. MITCHELL, APPELLANT,

vs.

RICHARD A. TILGHMAN.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK.

FILED DECEMBER 7, 1872.

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a UNITED STATES OF AMERICA,
Southern District of New York, ss:

I, Kenneth G. White, clerk of the circuit court of the United States of America for the southern district of New York, in the second circuit, do hereby certify that the foregoing pages, numbered from one to 1074, inclusive, contain a true and complete transcript of the record and proceedings had in said court, in the case of Richard A. Tilghman against Roland G. Mitchell, No. 2, as the same remain of record and on file in said office.

In testimony whereof I have caused the seal of the said court to be hereunto affixed, at the city of New York, in the southern district of New York, in the second circuit, this fifth day of December, in the year of our Lord one thousand eight hundred and seventy-two, and of the Independence of the said United States the ninety-seventh.

[SEAL.] KENNETH G. WHITE, *Clerk.*

1 The President of the United States of America to Roland G
[L. S.] Mitchell, greeting:

You are hereby commanded, that you personally appear before the judges of the circuit court of the United States of America for the southern district of New York, in the second circuit court, in equity, on the first Monday of April, A. D. 1871, wherever the said court shall then be, to answer a bill of complaint exhibited against you in the said court by Richard A. Tilghman, and to do further and receive what the said court shall have considered in that behalf. And this you are not to omit under the penalty on you of two hundred and fifty dollars.

Witness the Hon. Salmon P. Chase, Chief Justice of the Supreme Court of the United States, at the city of New York, on the eighth day of March, in the year one thousand eight hundred and seventy-one, and of the Independence of the United States of America the ninety-fifth.

KENNETH G. WHITE, *Clerk.*

GEORGE HARDING, *Compl't's Sol'r.*

The defendant is required to enter appearance in the above cause in the clerk's office of this court, on or before the first Monday of April, 1871, or the bill will be taken pro confesso against him.

K. G. W., *Clerk.*

2 (Indorsed:)

I hereby depute W. T. Smith to serve the within writ.
Dated March 8th, 1871.

GEORGE H. SHARPE,
U. S. Marshal, S. D. of N. Y.

William T. Smith, being duly sworn, deposes and says that he served the within subpœna upon Roland G. Mitchell, by leaving the same with him and showing him the original, on Friday, the 10th day of March, 1871.

W'M T. SMITH.

Sworn to before me this 11th day of M'ch, 1871.

JOHN A. SHIELDS,
U. S. Com'r.

Served per above affidavit.

GEO. H. SHARPE,
U. S. Marshal.

APRIL 3, '71.
Filed April 3, 1871.

3 Circuit court of the United States in and for the southern district of New York:

RICHARD A. TILGHMAN
v.
ROLAND G. MITCHELL. } In equity.

To the honorable the judges of the circuit court of the United States in and for the southern district of New York:

Richard A. Tilghman, of Philadelphia, in the State of Pennsylvania, and a citizen of said State, brings this bill against Roland G. Mitchell, of New York, in the State of New York, and a citizen of the southern district of New York.

And thereupon your orator complains and says that, on or before the 9th day of January, 1854, your orator was the true, original, and first inventor of a certain new and useful improvement in processes for purifying fatty bodies, not known or used before, and not, at the time of his application for a patent, in public use or on sale with his consent or allowance.

And your orator further shows unto your honors, that your orator so being the inventor of said improvement, and being a citizen of the United States aforesaid, made application to the proper Department of the Government of the United States for letters-patent, in accordance with the then existing laws of Congress, and, having duly
4 complied in all respects with the conditions and requisitions of said laws, on the third day of October, 1854, letters-patent of the United States, signed, sealed, and executed in due form of law, for his invention or discovery, were issued to the aforesaid Richard A. Tilghman, whereby there were secured to him, his heirs, executors, and assigns, for the term of 14 years from the 9th day of January, 1854, the full and exclusive right of making, using, and vending to others to be used, the said improvement.

And your orator further shows that a description or specification of the aforesaid improvement was given in the schedule to the said letters-patent annexed, accompanied by certain drawings referred to in said schedule, and forming part of said letters-patent.

That said letters-patent, and the specification thereto annexed, were duly filed in the Patent-Office, which, or an exemplified copy of which, your orator will produce, as your honors may direct, and a copy of which is hereto annexed, marked A.

And your orator further shows that, on or about November 11th, 1859, a suit in equity was commenced in the circuit court of the United States in and for the southern district of Ohio, by your orator against Michael Werk, for an infringement of said letters-patent.

5 That said suit came to final hearing at the session of said court holden at Cincinnati, November, 1860, on bill, answers, and proof; and, being fully argued by counsel, it was ordered, adjudged, and decreed, that the said Richard A. Tilghman, was the original inventor of the invention patented by him, and the said letters-patent were valid.

And your orator further shows that, on or about May, 1862, a suit in equity was commenced in the circuit court of the United States for the southern district of New York, by your orator against Roland G. Mitchell, of New York, the defendant herein, for an infringement of said letters-patent.

That said suit came to a final hearing at the session of said court held at New York, July, 1864, on bill, answers, and proof; and, being fully

argued by counsel, it was ordered, adjudged, and decreed, that the letters-patent No. 11,766, granted to said Richard A. Tilghman, October 3d, 1854, is a good and valid patent, and the said Richard A. Tilghman was the original and first inventor of the improvement described and claimed in said patent, and that said Roland G. Mitchell had infringed upon said patent, and upon the exclusive rights of the complainant under the same.

And your orator further shows that, afterwards, on or about the 15th day of March, 1867, the said Richard A. Tilghman, made application to the Commissioner of Patents, praying for an extension of said letters-patent, having complied in all respects with the then existing laws of Congress; and, on the 23d November, 1867, the said letters-patent were duly extended by the Commissioner of Patents, for the term of seven years from the 9th day of January, 1868, as by certificate thereon endorsed, or a duly authenticated copy thereof in court to be produced as your honors may direct, reference being thereto had will appear, and a copy whereof is hereto annexed marked "B."

6

And your orator further shows that, afterwards, about the 18th day of May, 1868, a suit in equity was commenced in the circuit court of the United States for the southern district of Ohio, by your orator, against Michael Werk, Thomas Kirby, and M. Schwartz, for infringment of said extended letters-patent. And that about the same time and in the same court, a suit in equity was brought by your orator against George Shillito, for infringment of said extended letters-patent.

And your orator further shows that the defendants in said last-mentioned two suits under the extended patent, alleged in their respective answers by way of defence, among other things, that the extension of said letters-patent was null and void, by reason of want of jurisdiction of the Commissioner of Patents, and also for want of due publication as required by law, and also for want of a true and faithful account of the profits of the invention as required by law, and also on account of fraud and collusion between the complainant and the Commissioner of Patents.

7

And that the defendants in said two suits in their answers alleged further, that your orator was not the first and original inventor or discoverer of the improvement described and claimed in said letters-patent, and in proof thereof, offered in evidence, among other things the following publications:

The Philosophical Magazine and Journal, London, 1823. Vol. 72, pages 318, 319, 474. An article entitled "Change of fat in Perkins' engine by water, heat, and pressure," a copy of which is hereto annexed marked "C."

The Quarterly Journal of Science, Literature and Art. London, 1823. Vol. 16, pages 172, 402.

The Polytechnisches Journal. By Dingler. Stuttgart, 1823. Vol. 12, page 466.

Neuer Schauplatz der Kiente und Handwerke. Weimar, 1852. Vol. 190 page 144.

Bericht über die Verhältniesse und die Werksamheit der polytechnischen Gesellschaft. Berlin, 1846. Vol. 3, page 46.

Philosophical Transactions of the Royal Society. Vol. 122. London, 1832. Pages 539, 544, 545, 571, 572.

8

English letters-patent to Radley and Meyer. Nov'r 25, 1850. No. 13081.

Engineers and Mechanics' Enclycopedia. London, 1835. Vol. 1, page 308.

English letters-patent to David Walton. Dec'r 23, 1840.
Journal of Franklin Institute. Philad'a, 1848. Vol. 15, pages 142 to 145.
Register of Arts and Sciences. London, 1824. Vol. 1, p. 369 to 371.
Austrian patent to William C. Hirchfeld. 21st Dec'r., 1843.
Morfit on Soap and Candles. Phil'a., 1847. Page 340.
Exposition Universelle de 1855. Paris, 1856. Vol. 1, p. 496.
Comptes Rendues. Paris, 1855. Vol. 41, page 973.

And the defendants in said two suits, alleged in their answers, that the invention as described and claimed in said letters-patent, was not useful and practicable, and in proof thereof, offered in evidence the testimony of one J. B. Moinier, a witness residing in Paris, France, which testimony had been originally taken before the master to whom was referred the question of damages in the first suit brought by your orator in this court against the present defendant, Roland G. Mitchell, and which testimony is now on the files of this court, and was admitted
9 by consent of your orator to be read in the suits under the extended patent against Werk and others and Shillito.

And that the defendants, Werk and others, and Shillito, in said two suits, examined as witnesses the present defendant, Roland G. Mitchell, and his former partner, Florence Verdin, to prove the want of novelty, utility, and practicability of the invention described and claimed in said letters-patent.

And that the said Michael Werk and George Shillito had been examined as witnesses on the part of the defendant, Roland G. Mitchell, in the first suit brought against him in this court by your orator for infringement of said letters-patent.

And your orator further shows that the said two suits against Werk and others, and Shillito, under the extended patent, came to final hearing at the session of said court held at Cincinnati in May, 1870, on bill, answers, and proofs; and, being fully argued by counsel, it was ordered, adjudged, and decreed that said Richard A. Tilghman was the original inventor of the invention patented to him, and that the said letters-patent and the extension thereof were valid.

But now, so it is, may it please your honors, that the said Roland G. Mitchell has actually combined and confederated with the said
10 Michael Werk, Thomas Kirby, John Kirby, M. Schwartz, and George Shillito, or some of them, to resist, embarrass, and destroy the exclusive privileges secured to your orators as aforesaid, and to use the said patented process without the license of your orator and in violation of his rights. And the said confederates, or some of them, including said defendant, have held meetings and entered into agreements, and contributed, or promised to contribute, money for the purpose last aforesaid, hoping to embarrass and oppress your orator by protracted and expensive litigation, so as to prevent your orator from enjoying his just rights aforesaid, and obtain the use of the said patented process without paying any compensation therefor. All of which is contrary to equity and good conscience, and in contravention of your orator's just rights in the premises.

And your orator further shows that your orator has extensively applied the said improvements to practical use, and has been, and, but for the infringement hereinafter complained of, would still be, in the undisturbed possession, use, and enjoyment of the exclusive privileges secured by the said letters-patent, and in receipt of the profits of the same.

And your orator further shows unto your honors, as he is informed

and believes, that the said defendant hereinafter named, well knowing all the facts hereinbefore set forth, is now constructing and using
11 the said patented improvement, or a process in some parts thereof substantially the same in construction and operation as in the said letters-patent mentioned, the exclusive right and privilege to make and use which, and vend the same to others to be used, is thus by law vested in your orator.

And so it is, may it please your honors, that the said defendant, as your orator is informed and believes, without the license of your orator, against his will and in violation of his rights, has made and used, and intends to continue still to make and use, the said improvement within the southern district of New York, all of which is in violation of the said letters-patent.

To the end, therefore, that the defendant may, if he can, show reason why your orator should not have the relief hereby prayed, and that he may make a full disclosure and discovery of all the matters aforesaid, and upon his corporal oath and according to the best and utmost of his knowledge, remembrance, information, and belief, full, true, direct, and perfect answer make to such of the several interrogatories hereinafter numbered and set forth, as by the note hereunder written he is required to answer. That is to say—

1. Whether the said original letters-patent were granted and issued to the said Richard A. Tilghman, on the 3d October, 1854?

2. Whether the said patent was, on the 23d November, 1867, renewed and extended for the period of seven years from the 9th January, 1868?

12 3. Whether the said suit in equity against Michael Werk was commenced and prosecuted and judgment and decree rendered as above set forth?

4. Whether the said suit in equity against Roland G. Mitchell was commenced and prosecuted and the judgment and decree rendered as above set forth?

5. Whether the said suit in equity against Michael Werk, Thomas Kirby, John Kirby, and M. Schwartz was commenced and prosecuted and the judgment and decree rendered as above set forth?

6. Whether the said suit in equity against George Shillito was commenced and prosecuted and the judgment and decree rendered as above set forth?

7. Whether the defendant has, at any time since the 9th January, 1868, and when, and during what period of time, used any process for decomposing fat into fat acids and glycerine by the action of water at a high temperature and pressure; and whether or no the said process was not substantially the same in principle and operation as the process patented to complainant, and how the same differed therefrom, if at all?

13 8. Whether the process used by defendant to decompose fat into fat acid and glycerine since January 9, 1868, was not substantially the same in principle and operation as that described as being used by said Roland G. Mitchell in his answer to the bill filed by complainant in this court in May, 1862; and how the same differed therefrom, if at all?

9. Describe minutely and in detail the process used by the defendant since January 9th, 1868, to decompose fat into fat acids and glycerine, stating particularly the proportion of fat and water, and the temperature and pressure used.

10. Describe minutely and in detail the process used by the defend-

ant prior to December, 1860, to decompose fat into fat acids and glycerine, stating particularly how many pounds of lime and how many pounds of sulphuric acid were used to each one hundred pounds of fat, and what was the temperature and pressure employed.

11. Whether any, and, if any, how much, fat has been decomposed into fat acids and glycerine by the defendant since the 9th January, 1868; and whether any, and, if any, how much, cost or expense; and how many pounds of lime and sulphuric acid have been saved by the use of the process employed since January 9, 1868, as compared with the process employed by the defendant prior to December, 1860?

14 12. Whether, in the process employed by the defendant since January 9, 1868, any, and what quantity of, fat was saved and utilized, which would have been lost and thrown away with the waste sulphate of lime, in the process employed by the defendant before December, 1860? Whether this saving did not amount to about two per cent. of all the fat worked?

13. Whether the solution of glycerine obtained by the process used by the defendant since January, 9th, 1868, was not of greater strength and purity than that obtained by the process used by him before December, 1860; and whether any, and how much, saving or profit arose therefrom?

14. Whether or no the said defendant has entered into any agreement, or has or had any agreement with the said Werk or Shillito, or any or what other person or persons, to contribute any, and what sum of, money, or other thing of value, for the purpose of opposing the rights of your orator under the said letters-patent, or paying the expenses of law-suits, or any and what other expenses incurred or to be incurred in resisting the said rights under the said letters-patent; and whether any, and how many meetings have been held, and by and be-

15 tween whom, and when and where; and whether any writing has been signed, and by whom, and what were its contents; and in whose possession is the original paper?

And now, to the end that the defendant may be compelled to account for and pay over the income thus unlawfully derived from the violation of the rights of your orator, as above, and be restrained from any further violation of said rights, your orator prays that your honors may grant a writ of injunction, restraining the defendant from any further construction, or sale, or use in any manner of said patented improvement, or any part thereof, in violation of the rights of your orator, as aforesaid; and that the machine or machines now in possession or use of the said defendant may be destroyed, or delivered up to your orator for that purpose. And, also, that your honors, upon the entering of the decree for an infringement, as above prayed for, may also proceed to assess, or cause to be assessed under your direction, in addition to the profits to be accounted for by the defendant, as aforesaid, the damages your orator has sustained by reason of such infringements; and that your honors may increase the actual damages so assessed to a sum equal to three times the amount of such assessment, under the circumstances of the wilful and unjust infringement by said defendant, as herein set forth. And your orator prays, also, for a provisional

16 or preliminary injunction, and for such other relief as the equity of the case may require, and to your honors may seem meet.

May it please your honors to grant unto your orator not only a writ of injunction conformable to the prayer of this bill, but also a writ of subpœna of the United States of America, directed to the said Roland G. Mitchell, and commanding him *him* to appear and answer unto this

bill of complaint, and to abide and perform such order and decree in the premises as to the court shall seem meet, and be required by the principles of equity and good conscience.

GEORGE HARDING,
Solicitor for Complainant.

The defendant is required to answer each of the foregoing interrogatories, numbered one to fourteen, inclusive.

GEO. HARDING,
Solicitor for Complainant.

UNITED STATES OF AMERICA,
District of ss :

Richard A. Tilghman, the complainant in the foregoing bill named, being duly sworn, says that, so far as the statements therein contained are within his own knowledge, they are true ; and, so far as they
17 are derived from the information of others, he ver'y believes them to be true. And he further says that he verily believes the said Richard A. Tilghman, in said bill named, is the original, true, and first inventor of the new and useful improvements in processes for purifying fatty bodies, which is described in the letters-patent granted to him on the 3d day of October, 1854, and mentioned in the foregoing bill. And your deponent verily believes that the title of him the complainant, as set forth in said bill, is true.

R. A. TILGHMAN.

Sworn to and subscribed this sixth day of March, A. D. 1871, before me.

SAM'L BELL,
Clerk Cir. C't U. S., E. D. of Pa.

19 EXHIBIT A.

No. 11766.

The United States of America to all to whom these letters-patent shall come:

Whereas Richard A. Tilghman, of Philadelphia, Pa., has alleged that he has invented a new and useful improvement in processes for purifying fatty bodies, which he states has not been known or used before his application; has made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said improvement, and that the same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the Treasury of the United States the sum of thirty dollars, and presented a petition to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose: These are, therefore, to grant, according to law, to the said Richard A. Tilghman, his heirs, administrators or assigns, for the term of fourteen years from the 9th day of January, one thousand eight hundred and fifty-four, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvement, a description whereof is given in the words of the said Tilghman, in the schedule hereunto annexed, and is made part of these presents.

In testimony whereof I have caused these letters to be made patent, and the seal of the Patent-Office has been hereunto affixed.

Given under my hand, at the city of Washington, this third day of October, in the year of our Lord one thousand eight hundred and fifty-four, and of the Independence of the United States of America the seventy-ninth.

ROBERT McCLELLAND,
Secretary of the Interior.

Countersigned and sealed with the seal of the Patent-Office.

[SEAL.] C. MASON,
Commissioner of Patents.

The schedule referred to in these letters-patent and making part of the same.

To all whom it may concern:

Be it known that I, Richard Albert Tilghman, of Philadelphia, have invented a new and improved mode of treating fatty and oily bodies, and I hereby declare that the following is a full and exact description thereof.

My invention consists of a process for producing free fat acids and solution of glycerine from those fatty and oily bodies of animal and vegetable origin which contain glycerine as their base. For this purpose, I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine. I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting point of lead, until the operation is complete. The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

The process may be performed more rapidly and also continuously by causing the mixture of fatty matter and water to pass through a tube or continuous channel, heated to the temperature already mentioned; the requisite pressure for preventing the conversion of water into steam being applied during the process, and this, I believe, is the best mode of carrying my invention into effect.

In the drawing hereunto annexed are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention.

Fig. 1 of the said drawing, is a vertical section of this apparatus, and Figure 2 shows the various parts of the apparatus in horizontal section: similar parts in these figures being marked with similar letters of reference.

I place the fat or oil in a fluid state in the vessel *a*, with from one-third to one-half its bulk of warm water; the disc or piston *b*, perforated with numerous small holes, being kept in rapid motion, up and down in the vessel *a*, causes the fat, or oil and water, to form an emulsion, or intimate mechanical mixture. A force pump, *c*, like those in common use for hydraulic presses, then drives the mixture through a long coil of very strong iron tube *d d d d*, which being placed in the furnace *e e*, is heated by a fire *f*, to about the temperature of melting lead. From the exit end *g* of the heating tubes *d d*, the mixture which has then become converted into free fat acids and solution of glycerine, passes on through another coiled iron tube *h h h* immersed in water, by which

it is cooled down from its high temperature to below 212° Farenheit, after which it makes its escape through the exit valve *i* into the receiving vessel.

The iron tubes I have employed and found to be convenient for this purpose, are about one inch external diameter, and about half an inch internal diameter, being such as are in common use for Perkins' hot-water apparatus. The ends of the tubes are joined together by welding to make the requisite length, but where welding is not practicable I employ the kind of joints used for Perkins' hot-water apparatus, which are now well known. The heating tube *d d d* is coiled several times backwards and forwards, so as to arrange a considerable length of tube in a moderate space. The different coils of the tube are kept about a quarter of an inch apart from each other, and the interval between them is filled up solid with cast iron, which also covers the outer coils, or rows of tubes, to the thickness of half or three-quarters of an inch, as shown in Fig. 2. This casing of metal insures a considerable uniformity of temperature in the different parts of the coil, adding also to its strength, and protecting it from injury by the fire.

The exit valve *i* is so loaded that when the heating tubes *d d d* are at the desired working temperature, and the pump *c* is not in action, it will not be opened by the internal pressure produced by the application of heat to the mixture; and, therefore, when the pump *c* is not in action, nothing escapes from the valve *i*, if the temperature be not too high. But when the pump forces fresh mixture into one end *j* of the heating tubes *d d d* the exit valve *i* is thereby forced open to allow an equal amount of the mixture, which has been operated upon, to escape out of the cooling tubes *h h* at the other end of the apparatus. No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture. For this purpose, whenever it may be required, the speed of the pump should be increased, so that the current through the tubes may be made sufficiently rapid to carry out with it any air remaining in them.

Although the decomposition of the neutral fats by water takes place with great quickness at the proper heat, yet I prefer that the pump *c* should be worked at such a rate, in proportion to the length or capacity of the heating tubes *d d d* that the mixture, while flowing through them, should be maintained at the desired temperature for ten minutes before it passes into the refrigerator or cooling parts *h h* of the apparatus.

The melting point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matters into fat acid and glycerine takes place with some materials (such as palm oil) at, or below, the melting point of bismuth, yet the heat has been carried considerably above the melting point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat, and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed can easily be determined.

To indicate the temperature of the tubes *d d d*, I have found the successive melting of metals and other substances of different and known degrees of fusibility to be convenient in practice; several holes, half an inch in diameter, and two or three inches deep, are bored into the solid parts of the castings surrounding the tubes, each hole being charged with a different substance. The series I have used consist of tin, melting about 440° F.; bismuth, at about 510° F.; lead, at about 612°

F.; and nitrate of potash, at about 660° F. A straight piece of iron wire passing through the side of the furnace to the bottom of each of the holes, enables the workman to feel which of the substances are melted, and to regulate the fire accordingly. It is important, for the quickness and perfection of the decomposition, that the oil and water, during their entire passage through the heating-tubes, should remain in the same state of intimate mixture in which they enter them. I therefore prefer to place the series of heating tubes in a vertical position so that any partial separation which may take place, while the liquids pass up one tube, may be counteracted as they pass down the next. I believe that it will be found useful to fix at intervals, in the heating-tubes, diaphragms pierced with numerous holes, so that liquids, being forced through these obstructions with great velocity, may be thoroughly mixed together.

I deem it prudent to test the strength of the apparatus by a pressure of ten thousand pounds to the square inch, before taking it into use; but I believe that the working pressure necessary, in using the heat I have mentioned, will not be found to exceed two thousand pounds to the square inch.

When it is desired to diminish the contact of the liquids with iron, the tubes or channels of the apparatus may be lined with copper. The hot mixture of fat acids and solution of glycerine which escapes from the exit valve of the apparatus, separates by subsidence. The fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means.

The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soaps, and applied to various purposes, according to their quality; and, when desired, they may also be first bleached by chemical agents, or purified by distillation, in a current of steam, or in a vacuum, as is now well understood. I prefer that the fatty bodies should be previously deprived, as far as practicable, of such impurities as would cause the discoloration of the fat acids produced; but when the fat acids are to be finally purified by distillation, this preliminary purification is of less importance.

When the sulphuric acid, nitrous fumes, or other corrosive agent, shall have been used for purifying, hardening, or otherwise preparing the fatty body to be operated upon, I take care that all traces of it shall be washed out, or neutralized, before passing it through the apparatus.

Some fatty bodies (particularly when impure) generate, during the process, a portion of acetic or other soluble acid, which might tend to injure the iron tubes; in such cases, I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes.

Having now described the nature of my said invention, and the manner of performing the same, I hereby declare that I claim, as of my invention, the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure.

R. A. TILGHMAN.

Witnesses:

JAMES MCCURLEY.

JOHN R. DARKER,

Consulate of the United States, London.

(Here follows diagram marked page 21.)

23 EXHIBIT B.

Whereas, upon the petition of Richard A. Tilghman, of Philadelphia, Pennsylvania, for the extension of the patent granted to him October 3d, 1854, antedated January 9th, 1854, the undersigned, in accordance with the eighteenth section of the act of Congress approved the 4th day of July, 1836, entitled "An act to promote the progress of the useful arts, and to repeal all acts and parts of acts heretofore made for that purpose," and the act approved the 27th day of May, 1848, entitled "An act to provide additional examiners in the Patent-Office, and for other purposes," did, on this 23d day of November, 1867, decide that said patent ought to be extended:

Now, therefore, I, Thomas C. Theaker, Commissioner of Patents, by virtue of the power vested in me by said acts of Congress, do renew and extend the said patent, and certify that the same is hereby extended for the term of seven years, from and after the expiration of the first term, viz, from the 9th day of January, 1868, which certificate being duly entered of record in the Patent-Office, the said patent has now the same effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof I have caused the seal of the Patent-Office to be hereunto affixed, this 23d day of November, 1867, and of the
24 Independence of the United States the ninety-second.

(Signed) T. C. THEAKER,
Commissioner.

[SEAL OF THE PATENT-OFFICE.]

25 EXHIBIT C.

The Philosophical Magazine and Journal, comprehending the various branches of science, the liberal, and fine arts, etc., by Alexander Tilloch, LL. D., and Richard Taylor, F. L. S., vol. LXII, for July, August, September, October, November, and December, 1823. Printed by Richard Taylor, Shoe Lane, London. Index, page 474, "Fat changed in Perkins' engine." Text pages 318, 319, "Change of fat in Perkins' engine by water, heat, and pressure."

Mr. Perkins uses in his steam-cylinder a mixture of about equal parts of Russia tallow and olive oil to lubricate the piston and diminish friction. The mixture is consequently exposed to the action of steam at considerable pressure and temperature, and being carried on by steam, it is found in the water, giving rise to peculiar appearances. The following is Mr. Farraday's account of it:

The original mixture is solid at common temperatures, but fuses at about 85° Fah. When boiled in alcohol, a small portion dissolves.

The water as it issues from the end of the ejection-pipe into the tub placed to receive it, and from which it is pumped up again into generator, appears white and translucent, and, after having been used some time, very much resembles thin milk. A scum is found floating
26 on it, which, when collected together, forms a soft solid, but when it has been long exposed to the action of the steam, and at a high temperature, is hard, like wax, nearly. It is always blac'. and dirty. A portion of this substance was digested in hot alcohol, and the clear solution set aside; flocculi separated in abundance from it on cooling, which, when dried, collected, and fused, gave a grayish substance, contracting and cracking as it cooled, with the lustre and appearance of

wax, but rather more brittle. It does not melt in boiling water, but at a higher heat melts, and ultimately burns like fat. It is rather lighter than water, it dissolves readily in alkalies—more readily, I think, than fat, and in this respect resembles Chevreul's acids of fat, as well as in its solubility in alcohol; the alkaline solution is turbid. It is not soluble in ether, or very slightly so; when burnt, it leaves an ash consisting principally of carbonate of lime.

The cold alcoholic solution, on evaporation, left a substance similar in many respects, but much softer, even fluid. It burnt in the same manner, leaving a slight ash of carbonate of lime. The merest trace of copper was found in these substances.

The action of the alcohol being continued, nothing at last remained but dirt and mechanical impurities. The softer portions from the surface of the water, were found to contain a quantity of unchanged fat and oil.

27 The milky water, on examination was found to be a mixture, probably, of this substance and water. It undergoes no change in appearance when left for many weeks, but, when filtered through good filtering paper, the latter portions came through clear and transparent, the altered fat being separated. When evaporated it leaves a substance having all the properties of the solid matter above described. The finely divided state of the substance, its solidity, and its near approach to the specific gravity of water, will perhaps, account for the length of time during which it will remain uniformly diffused through it.

28

29 Circuit court U. States, southern district of New York.

RICHARD A. TILGHMAN } *vs.* { In equity.
ROLAND G. MITCHELL.

Richard A. Tilghman, the complainant above-named, being duly sworn, deposes and says that, on the second day of March, 1871, he was at the place of business of the defendant, Roland G. Mitchell, No. 168 Pearl street, in the city of New York, and was then and there informed by Roland G. Mitchell, junior, the son and partner or agent of the defendant, that the said defendant was then using and working at his factory in the city of New York, the same process for decomposing fat into fat acids and glycerine by the action of water at a high temperature and pressure, in the Wright & Fouché apparatus, which the defendant had been using for several years past and since the year 1861.

And deponent further says, that said defendant, Roland G. Mitchell, was examined as a witness in the suit of R. A. Tilghman vs. M. Werk and others, about the 20th May, 1869, and stated, under oath, in the presence and hearing of this deponent, that he, the said Mitchell

30 was then decomposing every week about forty thousand pounds of fat into fat acids and glycerine by the action of water at a high temperature and pressure, in the Wright & Fouché apparatus, by the same process which he had been using since the year 1861.

And deponent further says that said defendant, Roland G. Mitchell, in his answer, filed Sept'r 1, 1862, to the bill of complainant in this court, stated that he was then decomposing fat into fat acids and glycerine by the action of water at a high temperature and pressure, in the Wright & Fouché apparatus.

And deponent further says that the said process of decomposing fat in the Wright and Fouché apparatus, as practiced by said Roland G. Mitchell, was adjudged by this court, on the 28th November, 1864, to be substantially the same in principle and operation as that patented to the complainant, October 3d, 1854, No. 11766, and to be an infringement thereof.

R. A. TILGHMAN.

Sworn and subscribed this seventh day of March, A. D. 1871, before me.

[L. S.] SAM'L BELL, *C'lk Cir. C't.*

31 (Endorsed:) Circuit court U. S., south'n dist. New York. Richard A. Tilghman vs. Roland G. Mitchell. In equity. Comp'l'ts bill.

Issue subpœna ret'ble 1st Monday of April next.

GEORGE HARDING, *Sol'r.*

Filed March 8, 1871.

32

33 Cir. c't U. States, southern dist. N. York.

R. A. TILGHMAN
vs.
R. G. MITCHELL.

Please enter my appearance for the defendant in the above cause.
Dated Ap'l 5, 1871.
Yours, &c.,

S. D. LAW,
Sol'r for Def't.

K G. WHITE, Esq.,
Clerk U. S. Cir. C't.

(Endorsed:) Cir. c't U. States, south. dist. N. York. R. A. Tilghman vs. R. G. Mitchell. Appearance of def't. S. D. Law, 4 Warren st., sol'r for def't. Filed April 5, '71.

34

35 Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

The answer of Roland G. Mitchell, defendant, to the bill of complaint of the said above-named complainant.

This defendant, now and at all times hereafter, saving and reserving to himself all and all manner of benefits and advantages of exception to the many errors and insufficiencies in the complainant's said bill of complaint contained, for answer thereunto, or unto so much or such

parts thereof as this defendant is advised is material for him to make answer unto, answering, says:

That he is informed and believes that letters-patent of the United States for improvements in processes for purifying fatty bodies, bearing date the 3rd day of October, 1854, and running from the 9th day of January, 1854, were granted to Richard A. Tilghman, the complainant in this suit, as is alleged in the bill of complaint in this cause; but that said Tilghman was the original, true, and first inventor or discov-
36 erer of the improvement patented to him as aforesaid, this defendant, on information and belief, here, as more particularly hereinafter, denies, and this defendant is advised and believes that said letters-patent are therefore null and void.

This defendant, further answering, says he is informed and believes that the said Richard A. Tilghman did, as is alleged in the bill of complaint in this cause, in or about the month of November, 1859, commence a suit in equity in the circuit court of the United States for the southern district of Ohio, against one Michael Werk, for an alleged infringement of said letters-patent, so granted to said Tilghman on the 3rd day of October, 1854, and that an interlocutory decision was made in said suit in favor of said Tilghman about the month of November, 1860, but this defendant denies that it was ordered, adjudged, and decreed in said suit, that the said Tilghman was the original inventor of the invention patented to him; and this defendant further says, that said suit was brought to a hearing, and said decison given therein, without a full or complete presentation to the court of the state of the art bearing upon the
37 branch of manufacture to which the said letters-patent relate, and this defendant therefore alleges and insists that said decision, so rendered in said cause, is not and was not in any manner conclusive as to the real merits of the issues in said cause.

This defendant, further answering, says that he admits that, in or about the month of May, 1862, a suit in equity was commenced in the circuit court of the United States for this circuit by said Tilghman, against this defendant, for an alleged infringement of said before-referred-to letters-patent; that said suit came to a final hearing before said court, on pleadings and proofs, in July, 1864, and that on said hearing a decision was made in said suit in favor of the complainant therein, sustaining said letters-patent of October 3rd, 1854, as good and valid, and also holding that defendant had infringed upon said patent; but this defendant further says that said suit was brought to a hearing, and said decision given therein, without a full and complete presentation to the court of all the testimony bearing upon the issues in said suit, and upon the state of the art relating to the branch of manufacture to which the said letters-patent pertain; that defendant, since the said hearing and the decision therein above referred to, has learned of and
38 has obtained certain testimony as to the practical operation of the said alleged invention of said Tilghman, described in his said patent, as applied or demonstrated by the said Tilghman, and under his direction, and proving its practical inability to produce the results claimed by said Tilghman in his said patent; that such testimony, as defendant is advised and believes, is highly pertinent to the issues in said cause, and if said testimony could have been introduced in said cause before the final hearing thereof, defendant is advised and believes that no order or decree on final hearing, such as were made in such cause, would have been made or entered in said suit; but, on the contrary, that such evidence would have shown the invalidity of said letters-patent, and have prevented any decree against this defendant in said suit.

And the defendant, further answering, says that, in and by the decretal order so rendered in said suit, liberty was given to this defendant to give bond in the penal sum of twenty thousand dollars, with a condition to pay on final decree in said cause, either in this court or in the supreme court, if an appeal is duly made and prosecuted, all sums of money which might be found due from him to the said Tilghman, on an accounting before Kenneth G. White, esq., a master of
39 this court, in which case no injunction should issue against defendant until a final decree in this cause; that this defendant duly gave such bond in said suit in the sum so fixed by this court, and that this defendant has since that time continued to carry on his business in the same manner as he was doing before the rendering of said decision, and the entry of said decree against him in said suit, and that said complainant has made no application in said suit to this court to have said order modified or set aside, or any injunction issued therein against this defendant.

And this defendant, further answering, says that it was also provided in and by said decretal order so entered against this defendant in said suit that it be referred to Kenneth G. White, esq., one of the masters of this court, to ascertain, take, and state, and report to this court an account of the gains and profits which this defendant had received, or which had arisen or accrued to this defendant from or by reason of the said alleged infringement by defendant of the said exclusive right of said complainant; that, under said order, a reference was taken to said master by said Tilghman, and testimony introduced therein by
40 both said Tilghman and this defendant; that such testimony having been so put in, the said master, upon a full and careful consideration thereof, and having heard counsel on the part of said Tilghman and of this defendant, made and rendered his report, wherein he found and reported "that no gains or profits have been proven to hav' been received by, or to have arisen or accrued to, the defendant from the manufacture, use, or sale of the improvements patented in the letters-patent set forth and described in the order of reference in this cause;" which report was duly filed with the clerk of this court, and a copy of which is hereto annexed, marked A.

This defendant, further answering, says that, in the said suit so brought against this defendant, the decision of the said court was also made under a misapprehension on the part of the court as to the mode of operation in the process set forth and described in the said patent of complainant, the learned judge considering that the specification did not require either that the vessel containing the mixture of water and fatty mater was to be entirely filled therewith, or that no steam was to be permitted in it, whereas the said specification made essential and necessary both such conditions, and defendant is advised and believes, and therefore avers, that, except for such misapprehension, the decision rendered in said suit would not have been against this defendant.

That said Tilghman, upon the rendering and filing of said master's report, took and filed exceptions thereto, and that said report and the exceptions thereto have been noticed for hearing at previous terms of this court, but have not been argued, and are again noticed for argument at the present term of this court, but that no hearing or argument has yet been had thereon.

And this defendant, further answering, says that he is advised
41 and believes, and will insist and maintain, that the said report, so made by said master in said suit, is in all respects correct and in accordance with the evidence adduced on said reference, and justified

by the law applicable thereto, and that this defendant has not made or received any gains or profits by reason of any alleged use of said complainant's said patent, and that the said complainant is not legally entitled to any damages against this defendant by reason of any alleged or pretended use, by defendant, of complainant's said invention.

And this defendant, further answering, says that he is informed and believes that, on or about the 15th day of March, 1867, the said complainant made application, in writing, to the Commissioner of Patents for an extension of the said letters-patent, so granted to him on the said 3rd day of October, 1854, and before referred to, and that said letters-patent, on or about the 23rd day of November, 1867, were extended to said complainant for the term of seven years from and after the ninth day of January, 1868; but this defendant is advised and believes, and therefore avers that said application for said extension was not made in conformity with the requirements of the then exist-
42 ing laws of Congress governing such applications, and in such a manner as to give the Commissioner of Patents jurisdiction of such application, but that such requirements were disregarded, evaded, and violated, both by said Tilghman and the Commissioner of Patents; that notice of such application, and of the time and place when and where the same would be considered, was not published as required by law, and in any papers published in any section of country interested adversely to the extension of said patent; and that the said Commissioner of Patents had never obtained any jurisdiction over said application; and that the proceedings had upon such application were not conformable to law; and that the extension of said letters-patent was granted without authority in law, and was obtained by fraudulent and deceptive proceedings as against the public, and by collusion between the said complainant and the then Commissioner of Patents, and is, therefore, null and void.

And this defendant, further answering, says he is informed and believes that the said complainant, previous to his obtaining his said original letters-patent, dated October 3rd, 1854, had obtained letters-
43 patent for the same invention in England, which said letters-patent had expired previous to the extension of said letters-patent, so granted on said October 3rd, 1854; and this defendant is informed and believes, and therefore alleges that no prolongation of the term of the American patent could legally be granted under the provisions of the law regulating extensions, and he insists that such extension is therefore illegal, and null and void.

And this defendant, further answering, says that he has been informed and believes that, in or about the month of May, 1868, the complainant, R. A. Tilghman, commenced, in the circuit court of the United States for the southern district of Ohio, a suit in equity against Michael Werk, Thomas Kirby, John Kirby, and M. Schwartz; and also, about the same time, commenced, in the same court, a like suit against George Shillito for an alleged infringement, by said defendants, of said extended letters-patent; and that the defendants in such suits, as defendant is informed and believes, alleged in their respective answers, among other things, by way of defence to said suits, that the extension of said letters-patent was null and void, by reason that the said application was not made in conformity with the requirements of the then existing acts of Congress, and because the requirements of the law as to ex-
44 tensions had not been complied with, and also on account of fraud and collusion between the applicant for said extension and the Commissioner of Patents, and also that the said Tilghman was

not the original inventor or discoverer of the improvement described and claimed in his said letters-patent; and defendant, on like information and belief, admits that such suits came on for final hearing, on pleadings and proofs, before said court, in the fore part of the year 1870, and that, on such hearing, decrees were entered therein in favor of said complainant. But this defendant, on like information and belief, denies that said defendants in said suits set up as a defense that the extension of said letters-patent was null and void by reason of want of jurisdiction of the said Commissioner of Patents; and he further alleges that the defences set up by said defendants in their said answers, as to the invalidity of the extension of said letters-patent, were not urged or argued to the court upon the final hearing of said suits, and were not considered or passed upon by the judge before whom said suits were argued and by whom they were decided; and defendant de-
nies that it was held or decided by said court that the said ex-
45 tension of said letters-patent was valid or legally obtained.

This defendant, further answering, admits that the testimony of one J. B. Moinier, a witness residing in Paris, and which testimony had been originally taken before the master to whom was referred the question of damages in the first suit before referred to, brought by said complainant against this defendant, was admitted by consent in said suits so brought by said complainant against said Werk and others, and against said Shillito; and this defendant also admits that he, as well as his former partner, Florence Verdin, were examined as witnesses in said suits against said Werk and Shillito, and that the said Michael Werk and George Shillito had also been examined as witnesses on the part of this defendant in the said suit before referred to against this defendant.

But this defendant, further answering, says that the decision of the court in said suits brought by the complainant in the southern district of Ohio, against said Werk and others, and against said Shillito, in favor of the complainant, was not based or founded upon, and does not
purport to have been founded upon the testimony introduced in
46 said causes, and was not a decision upon or as to the real merits of said suits as established by the evidence therein, but that such decision of said court in said suits was wholly based upon, and was expressly declared to be given by reason of, the former adjudications, made in reference to the original patent of said complainant in said suits before referred to, one decided in Ohio in 1860, and another in this circuit in the year 1864; that the honorable judge who rendered the said decision in said suits against said Werk and others and said Shillito declared in his said decision that he was not at liberty to consider the questions involved, unembarrassed by previous judgments, and that, although the record in such suits in reference to views which a superior court might take contained material additional proofs, they were not such as to authorize the same court to overrule its former deliberate adjudications, and that the cases already decided as to said patent must be followed; and that said judge, after having referred to the defences set up by the defendants in said suits, used the following language:

"I thus briefly advert to the leading objections solely to show that
they are disposed of by the said previous cases, and not to dis-
47 cuss them upon principle. Were I at liberty to treat the whole case upon principle, I fear I should be compelled to give the patent a more limited construction than it has received."

And this defendant, further answering, says that in said cases so de-

cided in the said southern district of Ohio, in favor of said complainant, the court refused to order an injunction against the defendants therein, but held that a bond should be received from the defendants, all of which will more fully appear by the decision of said court in said suits, and to which reference is hereby made, and a copy of which is hereto annexed marked B 1.

And this defendant, further answering, denies that he has combined and confederated with the said Michael Werk, Thomas Kirby, John Kirby, M. Schwartz, and George Shillito, or either or any of them, to resist, embarrass, or destroy any exclusive privileges legally belonging or secured to said complainant, or to use any invention of said complainants, without his permission; and further denies that he has held meetings, or entered into agreements with said persons, or any of
48 them, or contributed money, as is alleged in the bill of complainant, for such purposes, and to embarrass and oppress said complainant and prevent said complainant enjoying any of his just rights, or to obtain the use of complainant's patented process without paying compensation therefor.

And this defendant, further answering, denies that the said complainant has ever applied the said improvements or invention described in his said patent to practical use, either extensively or otherwise; and this defendant further alleges that the said alleged improvements or invention of said complainant, as set forth and described in his said patent, are incapable of being applied to practical use, and that the said letters-patent of the complainant are null and void, for the reason that no sufficient or adequate means are described or shown in the specification or drawings of the said letters-patent, whereby the said alleged invention can be reduced to practice; and, on the contrary, that the mode and means of practicing such invention described in said specification, and shown in said drawings and stated in said patent as being, in the belief of the patentee, the best mode of carrying
49 the invention into effect, is pernicious and dangerous, owing to the degree of heat and pressure required and would result in the destruction of the glycerine of the fat, and be otherwise impracticable and devoid of utility.

And this defendant, further answering, says that the claim in said letters-patent contained does not set forth a patentable subject-matter, and that by reason thereof the said letters-patent are void.

And this defendant, further answering, denies that he is now using, or has at any time since the 9th day of January, 1868, used the alleged improvements patented to said complainant, or a process substantially the same in construction and operation, as in the said letters-patent mentioned; and he further denies that he has, since that date, infringed upon the said letters-patent of the complainant, or upon any rights that are secured to him thereby, or that may lawfully be claimed by him under or by virtue thereof; and he submits to this honorable court that, in view of the state of the art to which said letters-patent pertain, as hereinafter referred to, he has good and lawful right to use the process
50 herein described, as employed by him, the same being, as this defendant believes and avers, a far superior process to that described in said letters-patent, and differing therefrom in principle, in mode of operation, and in effect produced.

And this defendant, further answering, says that he is now using, and has been since the said 9th day of January, 1868, using the same process and means for decomposing fatty acids which he was using at the time of the commencement of said former suit against him, and that

he has continually used such process, and has never used any other or different process.

To the several interrogatories propounded in the complainant's bill of complaint the defendant answers as follows:

1. On information and belief he says said original letters-patent were granted to the said Richard A. Tilghman on the 3rd day of October, 1854.

2. Defendant says, on information and belief, that an endorsement of extension of said letters-patent was made on such original patent by the Commissioner of Patents on the 23rd day of November, 1867, but
51 he alleges that such extension for the reasons hereinbefore given, was and is null and void.

3. Defendant says he is informed and believes that a suit was commenced by said Tilghman against Michael Werk, and that a decree was rendered therein, such as is hereinbefore more particularly set forth, and to which reference is hereby made as part of the answer to this interrogatory.

4. Defendant further says that a suit in equity was heretofore commenced and prosecuted against this defendant by said Tilghman, and that a judgment and decree was rendered therein, and such other proceedings had and taken therein as *is* hereinbefore more particularly set forth, and to which reference is now had as a part of the answer to this interrogatory.

5. Defendant further says, on information and belief, that a suit in equity by said Tilghman against Michael Werk, Thomas Kirby, John Kirby, and M. Schwartz, was commenced and prosecuted, and that a decree was rendered and proceedings had therein such as *is* hereinbefore more particularly set forth, and to which reference is made as part of the answer to this interrogatory.

52 6. Defendant further says, on information and belief, that a suit in equity against George Shillito was commenced and prosecuted, and that a decree was rendered and proceedings had therein such as *is* hereinbefore more particularly set forth, and to which reference is now made as part of the answer to this interrogatory.

7. This defendant, since the 9th day of January, 1868, has decomposed fats into fat acids and glycerine by a process or method patented to Wright and Fouché, in which water at a high temperature, and under pressure, is employed; but an active automatic circulation of the moisture through the fat is provided for, and such circulation is absolutely necessary for the operation of the process; and without such circulation the process would be more expensive than saponification by lime. Said process, so used by defendant, is not substantially the same in principle and operation as the process patented to complainant, but differs materially therefrom; not only in degree of temperature and pressure, but also in the circulation of the moisture through the fat, which is not permitted by complainant's process.

53 8. The process used by defendant to decompose fats into fat acids and glycerine, since January 9, 1868, is the same as that referred to in his answer to the bill filed in the former suit by complainant against defendant, and as fully described in the testimony in said suit introduced on the part of the defendant.

9. The process as employed by defendant since the 9th day of January, 1868, is as follows:

The apparatus consists of two boilers connected by two pipes, one of which connects with the upper portion of the upper boiler, and the other connects the bottom of the upper boiler with the lower part of the lower

boiler, running through the top of the latter. The lower boiler and a small portion of the upper boiler is filled with hot water, and the remaining portion of the upper boiler is filled to within about two feet of its hight, or about $\frac{19}{12}$ full, with hot fat; fire is then applied to the lower boiler, and the water subjected to a temperature of about 374° Far. The water being heated, rises with the steam, through the first mentioned pipe to above the surface of the fat, then descends through the fat with the water formed by the condensation of the steam, to the bottom
54 of the upper boiler, from whence it is conducted by means of the secondly mentioned pipe, to the lower part of the lower boiler, and this process of circulation is continually repeated; the pressure is run up to about twelve atmospheres, and maintained about twelve hours. The boilers used are about 2 feet in diameter, the upper boiler being about twelve feet and the lower boiler about six feet in hight.

10. The process used by defendant prior to December, 1860, was substantially as follows: A tank was used provided with steam-pipes filled with holes to let the steam enter the tank. Into this tank was put about a foot of water, and into this tank the fat was thrown and heated by steam, when there was added the milk of lime with a large excess of water, the tank was then covered, and the steaming continued for six or eight hours. This operation being completed, the glycerine produced was drawn off, and the fat acids, in combination with the lime, shovelled into an adjacent tank and heated by steam with diluted sulphuric acid. The fat acids thus liberated were then drawn off and settled, and then run into pans to form cakes, which were then
55 subjected to hydraulic pressure, and afterwards pressed in a hot press, until all traces of ollic acid were pressed out. Fourteen pounds of lime and twenty-eight pounds of sulphuric acid were used to each 100 pounds of fat, and the temperature was that produced by steam in contact with fat, lime, and water, the degree of which defendant cannot now state.

11. Since the 9th of January, 1868, this defendant has decomposed into fat acids and glycerine about four and a half million pounds of natural fat, saving by the Wright and Fouché process used by him, about six hundred and thirty thousand pounds of lime, and about eleven hundred and sixty pounds of sulphuric acid, but the cost thereof defendant cannot now state.

12. By the Wright and Fouché process used by defendant since January 9th, 1868, there may have been two per cent. of fat saved, but this depends upon the care exercised in obtaining the product.

13. The solution of glycerine now obtained by defendant is of greater strength and purity than that obtained prior to the use by him
56 of the Wright and Fouché process, commenced in December, 1860, but as defendant does not purify his glycerine he cannot state what the additional value is.

14. This defendant has not had or entered into any agreement with any persons, or contributed money or other thing of value for any of the purposes inquired of in the 14th interrogatory, or had meetings for any such object, and no writing of such character as enquired of has been signed to the knowledge of defendant.

57 And, further answering, the defendant says, on information and belief, that the said Richard A. Tilghman, was not the first and original inventor or discoverer of the improvements described and claimed by him in his said letters-patent, and, therefore, that said letters-patent are null and void; and, for the purpose of establishing the want of novelty of the said alleged invention, the defendant will, at the hearing hereof,

rely upon and offer in evidence the following several letters-patent and publications, to wit:

1. The Philosophical Magazine and Journal, comprehending the various branches of science, the liberal and fine arts, etc., by Alexander Tilloch, LL. D., and Richard Taylor, F. L. S. Vol. LXXII for July, August, September, October, November, and December, 1823, printed by Richard Taylor, Shoe Lane, London. Reference being had to the index of said volume, page 474, title "Fat changed in Perkins' engine," and to pages 318 and 319 of the text, under title "Change of fat in Perkins' engine by water, heat, and pressure."

2. The Quarterly Journal of Science, Literature, and Art, London, Jno. Murray, publisher, 1823. Vol. 16, page 402, title, "Fat,
58 change of by water, heat, and pressure." And page 172, title, "Change of fat in Perkins' engine, etc."

3. The Polytechnisches Journal Herausgegeben von Dr. Johann Gottfried Dingler. Zwölften Band. Jahrgang 1823. * * Stuttgart. Volume 12, article on page 466, title, "On the change of fat by water, heat, and pressure."

4. Neuer Schauplatz der Künste und Handwerke, CXCV. Band, (195 vol.,) die Kerzen- und Seifenfabrication. Von Christ. Heiser Schmidt. Weimar, 1852, p. 144.

5. Encyclopédie, Roret, Paris, 1849, pages 110, 111, 113, 114, 115.

6. Patent granted to Chevreul & Gay-Lussac, in France, January 5, 1825. Published in Description des brévets d'invention, vol. 41, page 392.

7. Bericht über die Verhältnisse und die Werksamkeit der polytechnischen Gesellschaft in Berlin. Drittes Heft. Berlin, 1846, page 46, paragraph commencing "40, Mr. Wolfensttin, mentioned a notice from a newspaper" * * * Mr. Kerfahl remarked thereupon that if tallow, etc." * *

8. Précis de chimie industrielle, par. A. Payan. Deuxieme édition. Paris, 1851, pp, 766 and 771.

59 9. Philosophical Transactions of the Royal Society of London, for the year A. D. 1832. Vol. 122, published in London, by Richard Taylor, page 517. Index title, "Castor-oil, remarkable change in, on the surface of the water in the cistern of the water-barometer."

Also the text commencing on page 539, title "Professor Daniel on the water-barometer, erected in the hall of the royal society." Particular reference being had to that part of the said article found on pages 544–5, containing the account of the placing of castor-oil on the surface of the water in the cistern or boiler, and to that portion thereof commencing with the words:

"Upon examining the oil upon the surface we found that it had undergone a very remarkable change," etc., p. 571–2, and reference being also had to the illustration or plate of said water-barometer boiler, etc., which accompanies said article.

10. Letters-patent granted to William Radley and Frederick Meyer, in England, dated November 25, 1850, numbered 13081, for "Treating fatty and other bodies to obtain products."

11. Comptes-rendues de séances, etc., vol. 37, p. 403, Paris, 1853, "Volatile fatty acids."

60 12. Journal für practische Chemié Herausgegeben von Otto Linne. Erdman und Richard Felix Marchand, Band, Leipzig, 1850, pp. 375–6–7. 41. Upon the application of the superheated vapors of water by Prof. E. A. Scharling.

13. Letters-patent issued in France, on the 11th of August, 1826, to

E. H. Manicler, under title "Preparation of a substance called vaxême, for making wax candles," Brévets d'inventions, tome XXIII, Paris, 1832, pp. 22, 23, No. 2006.

This defendant, further answering, craves leave to refer at the hearing hereof, to the letters-patent issued to Jacob Perkins, in England, dated December 10, A. D. 1822, for improved steam-engine, numbered 4732; and to the Register of Arts and Science, published in London, by G. Hebert, A. D. 1824, vol. I, pp. 369–371, inclusive, title "Perkins' steam-engine;" also, upon the question of novelty and the state of the art to the following letters-patent and publications, to wit:

14. Des machines et procédés spécifiés dans les brévets d'inven-
61 tion, de perfectionnement et d'importation dont la dureé est expirée. Tome XV, á Paris, 1828, p. 1424. 24 april 1823.

Patent of invention of five years, for a new method of melting tallow in close vessels, to Mr. Appert, of Paris.

15. English letters-patent of Nicholas H. Manicler, dated March 20, 1826, No. 5345.

16. Engineers and Mechanics' Encyclopedia, 2 vols., London, 1835, Tho's Kelly, publisher, vol. I, p. 308, title "Candles."

17. English letters-patent of David Walther, dated December 23, 1840, No. 8752.

18. Journal of the Franklin Institute of the State of Pennsylvania, for the promotion of the mechanic arts, February, 1848, (pp. 142, 143, 144, and 145 of vol. XV, third series,) article "On the decomposing power of water at high temperatures," by Richard A. Tilghman, read before the American Philosophical society, Philadelphia, August 20, 1847.

19. English letters-patent of William Hawes, dated June 12, 1839, No. 8101, for improvements in the manufacture of soap, parts of which improvements are also applicable to preparing tallow for the manufacture of candles.

20. English letters-patent of Samuel Guppy, dated August 1, 1839, No. 8180, for improvements in a certain process and apparatus in
62 the manufacture of soap.

21. English letters-patent of Alexander Alliott, dated February 3, 1851, No. 13490, for certain improvements in cleaning, dyeing, and drying machines, and in machinery to be used in sugar, soap, metal, and color manufacturing.

This defendant, further answering, craves leave to refer, at the hearing of this cause, to the English letters-patent granted to the complainant, dated January 9, 1854, No. 47, for improvements in treating fatty and oily matters, chiefly applicable to the manufacture of candles.

And this defendant, further answering, says that the said alleged invention, specified in said letters-patent granted to said complainant, was, or substantial and material parts thereof were, long prior to the pretended invention thereof by said complainant, and more than two years before his application for said letters-patent, described in the above-named public works.

And the defendant states, on information and belief, that, upon the questions of novelty, originality, and the prior state of the art, as
63 affecting the validity of said letters-patent of the complainant, and the question of infringement, the publications and patents hereinbefore referred to, except those numbered respectively six, (6,) eight, (8,) eleven, (11,) twelve, (12,) and thirteen, (13,) were not cited or offered in evidence by this defendant in the aforesaid suit prosecuted against him, and the same were not known to the court, as the defendant is informed and believes, at the time the said decree was made, and

he is advised and believes, and, therefore, avers that such evidence would have materially affected the decree in said suit.

And the defendant, having *more* fully answered all of said bill of complaint which he is advised it is material or necessary to make answer unto, does now deny the right of the complainant to the relief, or any part thereof, as prayed in his said bill; and prays to be hence dismissed, with his reasonable costs and charges in this behalf most wrongfully sustained.

R. G. MITCHELL.

S. D. LAW, *Def't's Sol'r.*
CHAS. M. KELLER, *of Counsel.*

64 UNITED STATES OF AMERICA,
Southern District of New York:

Before the subscriber, a notary public in and for the State of New York, on this first day of May, A. D. 1871, personally appeared Roland G. Mitchell, the defendant in the foregoing answer named, and by whom the same is subscribed, who, being duly sworn according to law, deposes and says that he has read the foregoing answer, and knows the contents thereof, and the statements therein contained, so far as within his knowledge, are true, and, so far as they are derived from information, he verily believes them to be true.

A. T. GURLITZ,
Notary Public.

65 A.

Master's report.

Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROWLAND G. MITCHELL.

In pursuance of a decretal order made in the above-entitled cause on the 1st day of December, A. D. 1864, by which it was referred to the undersigned to ascertain, take, and state, and report to the court an account of the gains and profits which the defendant has received, or which have arisen or accrued to him from infringing the exclusive rights of the complainant, by the manufacture, use, and sale of the improvements patented in the letters-patent upon which this suit was brought, and to report thereon to this court, I, Kenneth G. White, the master to whom the matter was referred, do report, that I have been attended by the counsel for the respective parties, and have taken and ex-
66 amined the testimony offered on the part of complainant and defendant, and do find that no gains or profits have been proven to have been received by, or to have arisen or accrued to the defendant, from the manufacture, use, or sale of the improvements patented in the letters-patent set forth and described in the order of reference in this cause.

All which is respectfully submitted.
Dated New York, February 4th, 1870.
(Signed) KENNETH G. WHITE, *Master, &c.*

Filed February 7th, 1870.

(Endorsed:) Circuit court of the United States for the southern dist. of New York. Richard A. Tilghman vs. Roland G. Mitchell. Answer. S. D. Law, sol. for def't. Filed March 1, 1871.

67 B.

Circuit court of United States, southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, AND OTHERS.
AND
RICHARD A. TILGHMAN
vs.
GEORGE SHILLITO.
} In chancery.

These cases were argued to Mr. Justice Emmons, in May, 1870, in Cincinnati.

On the 24th November, 1878, Judge Emmons delivered an oral opinion. The following is a report of the opinion, prepared under his inspection.

Judge EMMONS said:

That his other engagements would have rendered it impossible to have prepared a full written opinion, if the questions involved had not already been decided, and he at liberty to consider them unembarrassed by any previous judgments. Such a labor, however, in the present instance, he said was unnecessary, as already two written judgments one, by Judges McLean and Leavitt in this circuit, and the other by Justice Nelson in the southern district of New York, both in suits for the infringe-
68 ment of this patent, fully disposed of all the questions involved.

All the benefits, therefore, which occur to litigants having their conflicting views adjudicated in courts of original jurisdiction, that they may the better judge of the propriety of further pursuing the contest by appeal, have already been fully secured. In the prior suit in this circuit, the defendant, Werk, was a party. Although the record in this case, in reference to some views which a superior court may possibly take, contains some material additional proofs, still they are not such as to authorize the same court to overrule its former deliberate adjudications, and to disregard the judgments of a co-ordinate one in a case in all respects substantially like it; especially is this so where the judge delivering the opinion has taken so leading a part in all the discussions upon this subject in the court of last resort.

After much consideration I am confident that, without a violation of judicial propriety and the best interests of all who pursue or defend here, the cases already decided between these same parties must be followed. It would greatly impair the influence of the court and the confidence of the suitors, if any succeeding judge turned it into one of appeal for all questions previously decided. Where doctrines are reconsidered, as often they are and should be, the circumstances of the case must be exceptional, and furnish the justification for the action in each instance where it is taken. There are none such in this case—more than ordinary deliberation attended the previous discussions and judgments.

Judge Emmons referred to the opinions and read from them—we insert that of Justice Nelson in Tilghman vs. Mitchell, as it is short and constitutes the basis of the decision in this case. It is as follows:

"The bill is filed in this case, to restrain the defendant from infringing a patent granted to the complainant for a new and useful improvement in processes for purifying fatty bodies, bearing date October 3d, 1854, securing the exclusive right to the invention for fifteen years from the 9th of January preceding.

"The patentee declares that his invention consists of a process for producing free fat acids and solution of glycerine from fatty and oily
69 bodies of animal and vegetable origin, which contains glycerine as their base; for this purpose, he subjects the fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of these bodies to combine with water, and thereby obtain, at the same time, free fat acids and glycerine. He mixes the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture is to be placed in any convenient vessel in which it can be heated to the melting point of lead, until the operation is complete. The vessel must be closed, and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

"The patentee then states that the process may be performed more rapidly, and also continuously by causing the mixture of fatty matter and water to pass through a tube or continuous channel heated to the temperature already mentioned, the requisite pressure for preventing the conversion of water into steam being applied during the process.

"He then gives a particular description and drawing of this mode of carrying into effect his process, but claims no part of it as his invention.

"The patentee states, that the melting point of lead has been mentioned as the proper heat to be used in the operation of his process, as it has been found to give good results. But the change of fatty matter into fat acid and glycerine takes place with some materials, (mentioning some of them,) at a lower rate of heat, that the decomposing action of the water becomes more powerful as the heat is increased.

"He adds that by starting the apparatus at a low heat and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed can easily be determined.

"The fatty acids, he observes, thus produced may, like those obtained by other methods, be used in the manufacture of candles and soaps, and be applied to various purposes according to their quality. Some fatty bodies, particularly when impure, generate, during the progress, a portion of acetic acid, or other soluble acids; in such
70 cases, he says, that he adds a corresponding quantity of alkaline, or basic matter to the water and oil, before they are pumped into the tubes.

"The patentee then sets forth his claim, which is: 'Having now described the nature of my said invention, and the manner of performing the same, I hereby declare that I claim as my invention the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure.'

"It will be seen, not only from the specification, but also from the claim, that the improvement, patented by the complainant, is the invention of a process for producing fat acids and glycerine from fat or oily bodies—which process consists in the action of water upon these bodies at a high temperature and pressure, and which may be effected in any vessel adapted to such use.

"There is no claim for the vessel or machinery thus used; but as it was essential to the validity of the process, as an invention, to show how

it may be adopted to practical use, two modes are pointed out—one, any convenient vessel well known to the art, and which some of the witnesses called a digester; the other, the coil-apparatus. In either of which, as appears from the proofs, the process could be carried into practical effect, according to our construction of the patent.

"It was urged, in the argument by the learned counsel for the defendant, that, upon the terms of the specification, the vessel must be entirely filled with mixture of the water and fatty matter, and then be closed, and the contents heated to the point of melting lead, and no steam be permitted to be made in the vessel; and that, upon this hypothesis, no vessel could be made of sufficient strength to endure the pressure; but we do not agree to this construction. In the first place, the degree of heat was given only as a maximum, and under which the process could be most rapidly carried into effect. For the patentee, speaking upon this part of the specification, says, that no fixed degree of heat can be given, as the different fatty or oily substances that may be used will require different degrees; and that by starting the vessel at low heat and gradually increasing it the best temperature may be ascertained for the particular substance used.

71 "In the next place, we cannot agree that a fair construction of the specification tends to the conclusion, either that the vessel was to be entirely filled, or that no steam was to be permitted in it; no doubt it is true, as urged for the defendant, if thus filled, and the vessel closed, and the contents heated to the point of melting lead, or under a pressure that would prevent the existence of steam, the process would be utterly impracticable; and doubtless the patentee knew this would be the result, as well as any of the experts.

"It would require but the commonest knowledge and experience in the business of life to reach such a conclusion.

"This moderate degree of knowledge, at least, should be kept in view in construing the general terms of the description.

"Besides, the patentee does not direct that the vessel should be entirely filled, this is an inference of the learned counsel, from the direction that the vessel must be closed and be of great strength, so that the requisite amount of pressure be applied to prevent the conversion of water into steam.

"Now, all that was intended, as is apparent from the context, by the patentee was, that the pressure should be so great as to prevent the body of the water in the vessel from passing into steam, as the heated water was the element that separated the fatty acids and glycerine. That there would necessarily be some steam must have been obvious to the patentee as well as to any one of common observation.

"Now, upon this interpretation of the patent, and which, we think, is the sound one, we repeat what we have already said that the process could and has been carried into successful operation by the means pointed out by the patentee.

"Previous to the date of this invention, there were but two modes known or in practical use for decomposing fatty substances, and obtaining from them fatty acids and glycerine, one called the lime saponification process, the other known as the distillation process. It is not material to give a particular description of these modes of separating the fatty acids and glycerine; it is sufficient to say that they were different from the patentee's in the process or mode of producing the result,

72 much more expensive and tedious, and have generally gone out of use, both in this country and in England, since the complainant's improvement has become generally known and practised.

"We have looked through the proofs in the case with some care, and, without going into them in this opinion, are satisfied that the complainant was the first person that discovered the chemical fact, that fatty or oily substances could be decomposed and the fatty acids and glycerine separated by the action of water at a high temperature and under pressure.

"Then, as to the infringement, it is not material to enquire whether the vessel or machinery used by the defendant is or is not similar to that described in the complainant's patent.

"These constitute no part of his invention. If the defendant, or the person under whom he uses his machinery, have discovered new means of carrying into effect the complainant's process, he or they may be entitled to a patent for that improvement. But this would furnish no right to the use of the process.

'The question here is, does the defendant, whatever may be his vessel or machinery, manufacture or produce fat acids or glycerine from fatty bodies by the action of water at a high temperature and pressure, according to the process as explained by the plaintiff in his specification? We are satisfied that he does, and hence has infringed his patent.

"Our conclusion is that the complainant is entitled to a decree for an injunction and profits."

Judge Emmons then said: The apparatus and process employed by Mitchell are so substantially like those of the defendant's here that no serious attempt has been made to distinguish the two, beyond the use of lime in the one and its omission in the other. This difference, the prior cases determine, is immaterial. They both produce free fat acids and glycerine, by the action of highly heated water under pressure, in a mode according to the adjudications already made, like that covered by the complainant's patent.

The decisions of Judges McLean and Leavett was before Judge Nelson, and he is quite as pointed and goes quite as far in his
73 ruling as they. It will be seen his judgment covers every point now raised by the defendants.

They insist, first, that the claim of the patent includes only those higher degrees of heat at which lead and other substances mentioned in the patent will melt, and cannot be extended to include a temperature and pressure which can produce no useful and practical result, without the aid of lime or other alkalies. That, if so interpreted, it will include and render unlawful what was in actual use before. They show by the proofs, that apparatus and modes of operations, which it is difficult to distinguish from their own, were used by others and described in public printed pooks, anterior to the complainant's patent, and insists that its construction, if it includes them, will avoid it. Were I to determine this matter, uninfluenced by precedent, I should require some additional investigation and argument before rejecting this view. I am by no means certain it cannot be sustained. All the considerations, however, which have been laid before me have been deliberately overruled in the cases referred to. Both opinions pointedly say, that the claim of the patent is not to be confined to those high degrees of temperature and pressure described in it, and their reasoning would clearly include those employed by the defendants.

In view of the case of O'Reilly vs. Morse, 15 Howard, 62, among the points which have given me most difficulty, is that which insists that if the patent is to be thus construed it is void as one for an abstract principle as distinguished from a process. The opinions of the minority of the court in this case, the able criticism of Mr. Curtis in the fourth

chapter of the last addition of his Treatise on the Law of Patents, commend themselves to my judgment. Had I the liberty of deciding whether the discovery of a useful fact in science, accompanied by the description of some mode for applying it in manufactures and the arts was the subject of a patent which should protect the discoverer from all substantially similar applications of the principle, I should readily hold and feel that both sound principle and many adjudications would justify it. If Morse was the discoverer of the power of electro-magnetism, to
74 mark signs at a distance, and described machinery for effecting the object, I should say that whoever made an improvement upon his machinery should reap the benefit of that improvement only, and still pay tribute to him, but for whose discovery no such improvement could have been made. But as I understand the opinion of the majority in O'Reilly vs. Morse, it establishes a different doctrine, and confines the protection of a patent to the apparatus described in it for applying practically a new scientific discovery. I have nothing to do with the inconsistencies to which such a doctrine may lead, or with those modifications it is highly probable some of the generalities of the judgment may receive, when on appeal they are asked to be applied in this case. But for the two judgments by which I feel bound, I should have been unable to answer the argument of the defendant's counsel, that within, O'Reilly vs. Morse, the complainant's patent is void, if it is to be construed as including all temperature and pressure above 212°. They rely upon the following passage: "Now, whether the telegraph is regarded as an art or a machine, the manner and process of making or of using it must be set forth in exact terms. The act of Congress makes no difference in this respect between an art and a machine."

"Whoever discovers that a certain useful result will be produced in any art, machine, or manufacture, or composition of matter, by the use of certain means, is entitled to a patent for it; provided he specifies the means he uses in a manner so full and exact that any one skilled in the science to which it appertains, can, by using the means he specifies, without any addition to or substraction from them, produce precisely the result he describes. And if this cannot be done by the means he describes, the patent is void. And if it can be done, then the patent confers on him the exclusive right to use the means he specifies to produce the result or effect he describes, and nothing more.

"And it makes no difference in this respect whether the effect is produced by chemical agency or combination, or by the application of discoveries or principles in natural philosophy, known or unknown before his invention, or by a machine acting altogether upon mechanical prin-
ciples. In either case he must describe the manner and process
75 as above mentioned, and the end it accomplishes. And any one may lawfully accomplish the same end without infringing the patent if he uses means substantially different from those described."

The whole argument of the chief justice, I think, clearly shows, that by the words "means described" he intends "apparatus," "modes of operation described." That he does not include in the word "means," the scientific principle or fact discovered, because this is the very thing he was arguing could not be protected by a patent. He would seem to say although Mr. Tilghman has discovered the chemical fact that water alone, under high temperature and pressure, will decompose fatty bodies, and has discovered an apparatus for accomplishing the purpose, his patent cannot protect him from the employment of the principle in producing the same result, provided it is done by some mode not mechanically the equivalent of that described in the patent. With this

decision unmodified, I should hesitate before granting an injunction in this case, were it the first one which had stood for judgment in this court. But Judges McLean and Leavitt pointedly meet the argument made from this decision, and reject its application to this patent. There is no attempt at reconciliation. This case and the 15 Howard are not compared. They decide simply that Tilghman's patent is one for a process, as distinguished from a mechanical invention, and declare that the process consists in the use of water at a high temperature and pressure, and not in any apparatus or mechanism for its employment. That if the defendant, Werk, employs the chemical fact or principle that water alone will effect decomposition, it is pro tanto an infringement, notwithstanding he at the same time makes use of an alkali to aid the result, and a mechanism substantially variant from the complainant's. The same point is involved in the judgment of Judge Nelson, as the apparatus of Mitchell is quite as distinguished from that of the complainant as is that of the defendant in this case.

The defendants insist, in the second place, that the complainant has failed to prove that they produce acid and glycerine by the sole agency of water in its liquid form. I think the proofs do show, that the
76 defendants used the principle of the patent, as construed in the preceding cases, and this is held to be an infringement. In view of such construction, the much discussed question of precisely how lime performs its office,—just where water begins and where it ends its agency, is quite immaterial. The defendants do use liquid water under a very high pressure, in conditions decided to be a violation of complainant's rights. Were it conceded, therefore, that it does not appear that defendant has produced acid and glycerine by the sole agency of water, no effect is worked in the argument. Defendants have taken complainant's principle and combined it with something else, and it is for this use in combination that they are sued. I do not understand that an argument is made, either that no free acid and glycerine are produced, or that no part of it is due to the use of highly heated water under pressure; that is, such pressure as Judges McLean, Nelson, and Leavitt hold is within the claim of the patent.

It is said, thirdly, the patent is void for want of novelty, and especially if it is to be deemed a patent for a principle. The testimony of all the experts that decomposition by water, whether in a liquid form or in the form of steam, is dependent upon the same chemical law, is much relied upon. It is true that the experts upon both sides, concede that in each instance the result is produced by the assumption by the fatty body of certain elements of water in the same general mode, and that in the broadest sense this effect, whether produced by liquid water or steam, would depend upon the same general law. Although some of the experts do not swear pointedly in reference to it, none of them expressly deny this; others distinctly state, that when this general law is utilized through the medium of steam upon the one hand, and liquid water under high pressure, upon the other, the two modes are recognized as different chemical "processes." It is a different chemical fact or principle, if you will, that water alone will produce this effect, more rapidly and better that steam. It is this fact which is novel, and which has been decided to be sufficiently important to entitle the complainant to a patent. And although the defendants, I think, have succeeded in showing that the general law, that certain elements of water are as-
77 sumed by fatty bodies and results in decomposition, was announced before complainant's patent, and they may have made this somewhat more clear in this than in the preceding cases, it

is immaterial, for the reason that such broad general principle is not embodied in the patent. It is only the subordinate fact that this more general chemical law can be carried into effect by water alone, which constitutes the principle or chemical process patented to the complainant. The defendant may employ the more general principle without stint; but, in so doing, he must not use what in two cases has been ruled to be complainant's discovery, that by water alone, under high temperature and pressure, this before known law may be practically utilized.

Under a fourth head, the defendants argue that the patent is void as useless and impracticable. But the whole argument rests upon the assumption that the high degree of temperature and pressure are alone contemplated. When this is rejected, this position is answered.

I thus briefly advert to the leading objections of the defense, (by no means going over all,) solely to show that they are disposed of by the previous cases and not to discuss them upon principle. I repeat: Were I at liberty thus to treat the whole case, I fear I should be compelled to give the patent a more limited construction than it has received. In making this suggestion, I am influenced by no narrow rule of interpretation. I am in favor of no such rules. But in that liberal spirit which in modern times has so justly sought to give inventors and discoverers the full fruits of everything which they describe and claim, it seems to me that he who announces a discovery and prescribes the means of its employment in language like that contained in this patent, so well calculated to enforce the idea that vessels of impracticable strength and water at such excessively high temperature and pressure were necessary to produce results, ought not to have the benefit of all possible applications of which any principle involved is capable. Indeed, I should suppose from the specifications and claim, from the history of complainant's efforts since his patent, and the progress which was subsequently made in arriving at the truth, that lower temperature would produce
78 profitable results; that the fact which he discovered was not the one of which defendants are availing themselves; not the general fact that water will produce beneficial results under heat and pressure, including as well those moderate degrees which ordinary vessels then in use might endure, but the more limited one, that it will do so only in the extraordinary conditions disclosed in the patent. I cannot see how any intelligent chemist and mechanician, with all the light which the last fourteen years has thrown upon this subject, could write such a specification, and so persistently insist upon the high temperatures set forth, if he intended to include what is now claimed as within the patent. It is a little singular that no practical process is literally described. The actual descriptions are misleading and deceptive. We include lower degrees and other operations by an implication, I fear, springing from what is now familiar, and became so at an early day, I grant, after the patent; but the knowledge springing, I think, from facts and from sources other than the teaching of this specification. If, at the period it issued, an experimentor was about to try the defendant's apparatus and processes, in the hope that a moderate temperature, aided by a small quantity of lime, would produce good results, had read this patent, and believed what it seems to me it would teach, nine intelligent men in ten, he would undoubtedly have paused in his attempts, convinced that he had misconceived the conditions in which alone heated water would perform its work. There seems to me a wide range between what an intelligent workman would construct from the complainant's description and drawings and this apparatus of the defendants.

However, I do not pursue further several other reasons, which would, in other circumstances, cause me to doubt the propriety of enjoining the defendants. I am disposing of the first patent case ever argued before me, involving a department of law into which, when at the bar, I seldom looked at all, and never laboriously and critically. This cause, owing to the condition of knowledge on my part, has caused me much labor and study, none the less because I was in the outset, as I repeatedly remarked to counsel on the argument, impressed with the idea, that the previous judgments were decisive of all the points involved.

79 It is also said the defendants are protected by a license. I have no difficulty upon this point. The instrument under which the defendants claim, construed according to the intentions of the parties to it, would confine its operation to a period which expired before the acts complained of in the bill.

I should listen with much respect to an application for a re-argument upon this single question, whether this case can be distinguished from those referred to.

The usual degree will be entered.

I am disposed to think a bond should be received, instead of absolutely closing the works of the defendants. I cannot be present at the settling of the decree, and this must be left to my brother, Judge Leavitt.

80

81 Circuit court of the U. S., southern district of N. Y.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL. } In equity.

The replication of Richard A. Tilghman, complainant, to the answer of Roland G. Mitchell, defendant.

This repliant, saving and reserving all and all manner of advantage of exception to the manifold insufficiencies of the said answer, for replication thereunto, saith that it will aver and prove the said to be true, certain, and sufficient in the law to be answered unto; and that the said answer of the said defendant is uncertain, untrue, and insufficient to be replied unto by this repliant, without this, that any other matter or thing whatsoever in the said answer contained, material or effectual in the law to be replied unto, confessed and avoided, traversed or denied, is true; all which matters and this repliant is, and will be, ready to aver and prove as this court shall direct, and humbly prays as in and by the said bill he has already prayed.

GEORGE HARDING,
Solicitor and Counsel for Complainant.

82 (Endorsed: Circuit court of the United States, southern dist. of New York. Richard A. Tilghman vs. Roland G. Mitchell. In equity. Replication. Geo. Harding, sol'r for compl't. Filed March 6, 1871.

83 Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

It is hereby stipulated and agreed by and between the parties to the

above suit and their respective solicitors, that the testimony and exhibits heretofore taken and filed in the suit of R. A. Tilghman v. M. Werk, in the circuit court of the United States for the southern district of Ohio, and in the former suit of R. A. Tilghman v. R. G. Mitchell in this court, and in the reference in said last-mentioned suit under the decree therein, to Kenneth G. White, esq., one of the masters of said court, and in the suits of R. A. Tilghman v. M. Werk, T. Kirby, and others, and R. Tilghman v. G. Shillito, in the circuit court of the United States for the southern district of Ohio, as the same are contained in the printed records of the parties in said suits and proceedings, may be read and used at the hearing of this suit with the same effect as if they had been originally taken and filed herein, either party to be entitled to put in additional testimony, with right to the other party to reply thereto.

84 It is also agreed that the letter of R. A. Tilghman, dated London, June 25, 1856, and the letter of J. P. Wilson, dated London, July 13, 1865, as contained on pages 326 to 329 of complainant's printed record in the suit of Tilghman v. Werk, Kirby, and others, and admitted therein (page 326) to be genuine communications, are admitted in like manner so to be in the present suit.

It is also agreed that the prima facie testimony, on the part of the complainant in this suit, is now closed, and that the testimony, on the part of the defendant, shall be closed within sixty days from this date.

Dated May 30, 1871.

GEORGE HARDING,
Per B. C. TILGHMAN,
Solicitor for Complainant.
S. D. LAW,
Solicitor for Defendant.

85 Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

It having been heretofore stipulated and agreed in this cause, by a certain stipulation therein, bearing date the 30th day of May, 1871, having reference to the testimony in this cause, and what might be used as testimony therein, that, together with certain other testimony, the testimony and exhibits taken and filed in the former suit of R. A. Tilghman vs. R. G. Mitchell, in this court, and in the reference in such suit, under the decree therein, to Kenneth G. White, esq'r, one of the masters of this court, as contained in the printed records thereof, might be read and used at the hearing of this suit with the same effect as if originally taken and filed in this suit.

And said former suit of R. A. Tilghman v. R. G. Mitchell, in this court, having been taken on appeal to the Supreme Court of the United States, and the record therein having been made up and filed with the clerk of the said Supreme Court:

86 It is hereby stipulated and agreed by and between the parties to this suit, and their respective solicitors, that the said testimony and exhibits, so taken and filed in said former suit, and in said reference therein as before set forth, though made a part of the testimony and record in this suit, by said stipulation of May 30th, 1871, need not, as a matter of fact, be incorporated in extenso into and made an actual

part of the record in this cause, and sent as such to the Supreme Court of the United States, on the appeal thereto in this cause, should such appeal be taken; but that the record in this cause, as sent to the said Supreme Court, may and shall embrace and contain only the rest of the testimony taken and filed therein, (or all of such testimony and exhibits, except that so taken in said former suit in this court, between the same parties, and in the said reference therein,) and that the record in said former suit, as sent to the said Supreme Court, may be read and used, on the argument of this cause, by the parties thereto, as a part of the record of this suit, and that such record shall be and is made a part of the record in this suit, as fully and to the same effect, as if the same was, actually and in extenso, incorporated into the record of this suit, in this court, before or on the appeal thereof.

87 Dated Oct. 11, 1872.

GEORGE HARDING,
Compl't's Sol'r.
S. D. LAW, *Def't's Sol'r.*

(Endorsed:) Circuit court of the United States, southern district of New York. Richard A. Tilghman vs. Roland G. Mitchell. Stipulation as to record. Filed Oct. 31, 1872.

88

89 Circuit court of the United States, south. dist. of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL. } No. 2.

It is hereby stipulated and agreed by and between the parties to the above suit and their respective solicitors, that the printed records on the part of the complainants and defendants in the following causes, viz: in the suit of R. A. Tilghman vs. M. Werk, record from page one to page one hundred and eleven, inclusive, on the part of said complainant, and from page one to page fifty-four, inclusive, on the part of the defendants; in the first suit of R. A. Tilghman vs. R. G. Mitchell the record as made up on appeal to the Supreme Court of the United States Sept. 21, 1871; in the suit of R. A. Tilghman vs. M. Werk, Kirby et al., and vs. G. Shillito, record from page 1 to page 336, inclusive, on the part of the complainant, and from page 1 to page 298, on the part of
90 the defendant; and in the second suit of R. A. Tilghman vs. R. G. Mitchell, record from page 1 to page 2d, inclusive, on the part of the complainant, and from page 3 to page 132, inclusive, on the part of the defendant; and the stipulations in said suit shall form and constitute the record on appeal to the Supreme Court of the United States.

Dated 27 Nov'r, 1872.

GEORGE HARDING,
Compl't's Solicitor.
Per B. C. TILGHMAN.
S. D. LAW, *Def'ts' Sol'r.*

(Endorsed:) Circuit court of the United States, south. dist. of New York. Richard A. Tilghman vs. Roland G. Mitchell. No. 2. Stipulation as to record. Filed Nov. 30, 1872.

91 Circuit court of the United States in and for the southern district of New York. In equity.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

To ROLAND G. MITCHELL:

You will please take notice that, on the eighth day of April, at the opening of the court on that day, or as soon thereafter as counsel can be heard, a motion will be made before the justices of this honorable court at New York, in the State of New York, for an injunction to issue against the defendant in this suit, restraining and enjoining the said defendant, pursuant to and in accordance with the prayer of the bill of complaint filed in this cause, and that said motion will be made on said bill of complaint, and the affidavits, papers, and documents, copies of which have been served upon you.

Yours, &c.,

Dated.

GEORGE HARDING,
Solicitor for Complainant.

Service accepted.

Solicitor for Respondent.

92 (Endorsed:) Richard A. Tilghman vs. Roland G. Mitchell. In equity. Notice of motion. Filed M'ch 8, 1871.

93 Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROWLAND G. MITCHELL.

SOUTHERN DISTRICT OF NEW YORK, *ss:*

Rowland G. Mitchell, the above-named defendant, being duly sworn, deposes and says that he is the same person mentioned and referred to in the bill of complaint, against whom a suit in equity was brought in this court by the above-named complainant, in or about the year 1862, for an alleged infringement of certain letters-patent granted to said complainant on the 3rd day of October, 1854, for "an improvement in processes for purifying fatty bodies," and in which suit a decree was rendered in favor of the said complainant in the year 1864, as is alleged in the complaint in this cause.

Deponent further says that the defence put in by deponent in said suit so first brought against him in 1862, was put in under the advice of deponent's then solicitor, George C. Goddard, esq., and included such particulars of defence as were at that time known to deponent, and as deponent was advised were material and necessary;

94 but deponent further says that, since the decision and decree in said suit, he has gained information as to other and important matters of defence to the alleged claim of complainant, under his said patent or the extension thereof. And deponent further says that such further defences would have been set up by deponent in said first

suit, had the same been known to deponent at the time he put in his answer to such suit, or before the final hearing in such suit.

Deponent further says he has fully and fairly stated such new matters of defence to S. D. Law and Charles M. Keller, esq's, his present solicitor and counsel, and that deponent is advised by his said counsel that such new matters of defence are material and important to the defence of deponent in this present suit; and he further says that he has put in and filed his answer to the bill of complaint in this suit, and that such new and further matters of defence have been set up in the answer of deponent in this present suit now brought against him, and in which the present motion for an injunction has been made.

Deponent further says that the allegations and statements contained and set forth in such answer in reference to the said suit so com-
95 menced by said complainant against this deponent in 1862, and as to the proceedings in said suit under the order of reference therein, are in all respects true; that the proceedings on such reference were necessarily very considerably protracted, as an important part of the testimony therein had to be taken under commission in France and in other places than in this district, but deponent further says that such proceedings were not unnecessarily protracted or delayed by him, and that the report of the master in said cause was not rendered until the 7th day of February, 1870; that, upon the rendering by the master of his report in such suit, the complainant took exceptions thereto, which exceptions were filed on or about the 1st day of March, 1870, and that such exceptions have not yet been argued on the part of complainant.

Deponent further says that the said defences set up in the present suit, and which were not set up in deponent's answer in said first suit, have reference to, and materially affect, the questions of novelty and utility of the alleged invention of complainant described and claimed in his said patent, and have reference also to the practicability of said alleged invention, and to the manner of operating or carrying out the process purporting to be described in complainant's said patent,
96 and that deponent is advised and verily believes that if such defences could have been set up in said first suit and the testimony in relation thereto could have been before the court at the final hearing thereof, that such defences and testimony would have materially modified, if not wholly changed, the character of the decission and decree in said cause and the decree entered therein. Deponent further says that evidence as to some of such further matters of defence so learned by deponent since the argument and final hearing in said cause first commenced against him, and which have been set up as before stated in the answer in this suit, including the testimony of one J. B. Moinier, of Paris, France, was put in on the part of deponent on the hearing before the masters in said first suit, under the advice of counsel, as having a bearing upon the question arising before such master; that such evidence so put in on said hearing before the master is contained in the printed record of the defendant's testimony on such reference, to which, for greater certainty, deponent craves leave to refer, and to which testimony deponent hereby refers as a part of this affidavit.

Deponent further says, as he is informed and believes, that the
97 testimony of said J. B. Moinier, and also some other portions of the testimony so put in on the part of deponent on said reference, before said master, was offered in evidence on the part of defendants in certain suits brought by said complainant, R. A. Tilghman, under his extended patents, in or about the year 1868, in the circuit court of the United States for the southern district of Ohio: One against Michael

Werk, Thomas Kirby, John Kirby, and M. Schwartz, and the other against George Shillito, and in which suit decrees were entered in favor of the complainant in May, 1870; but deponent further says that the decision in said suits in favor of the complainant, by the honorable judge before whom they were heard, was not founded upon, and did not purport to be founded upon, the testimony introduced in said suits, but that the said decision in said suits was based upon, and was declared to be rendered by reason of, adjudication rendered in former suits brought by said complanant under his original patent before being extended, and in suits in which the defence was substantially different from the defence interposed in said suits so decided in Ohio in 1870, and in which the testimony was widely different, and in which the testimony of said Moinier was not in any manner introduced; and that such
98 decisions were not in any respect decisions upon the merits of said suits, as established by the evidence therein, or in any respect conclusive upon the pertinency or bearing of such testimony; and this deponent further says that no adjudication has been rendered in any suit under complainant's said patent, by any court of competent jurisdiction, which has been in any manner founder upon a consideration of the said further defences before referred to and set up in the answers of deponent in this suit.

Deponent further says that the said decission and decree made and rendered in said former suit brought against deponent by said complainant, was made under a misapprehension by the court as to the mode of operation in the process set forth and described in complainant's patent; that, in and by the description contained in said patent, the vessel containing the mixture of water and fatty matter, is required to be entirely filled therewith, and closed so that no steam can be permitted therein; that, on the *the* final hearing of said suit it was urged, on the part of deponent's counsel, that, by the terms of the specifications of complainant's said patent, the vessel must be entirely filled with the mixture of water and fatty matter, and then be closed, and the contents heated to the point of melted lead and no steam be permitted to be made in the vessel; and it was argued that no vessel could be made of sufficient
99 strength to endure such pressure, but that the honorable judge before whom such cause was argued, held that the specifications of said patent did not require the vessel to be entirely filled, or that no steam was to be permitted in it, but that said judge, in connection therewith, used the following language:

"No doubt it is true, as urged for the defendant, if thus filled, and the vessel closed, and the contents heated to the point of melting lead, or under a pressure that would prevent the existence of steam, the process would be utterly impracticable."

Deponent further says, after the argument of said suit, he, deponent, had a conversation with said R. A. Tilghman, the complainant in said suit, and also the complainant in the present suit, and that said Tilghman then himself admitted to deponent that, according to the process described, or intended to be described, in his said patent, the vessel was required to be entirely filled with the mixture of water and fatty matter, and gave his reasons therefor.

Deponent further says that, on the hearing before the master before refer'ed to, deponent was enquired of and gave testimony as to his said conversation with said Tilghman as to his said patent, and the required condition of the contents of the vessels in which the fat was to be treated, (which testimony will be found on pages 132 and 133 of the
100 printed record;) that said Tilghman was himself afterwards ex-

amined in said reference, and did not in any manner contradict or attempt to deny his said admission so made to deponent.

Deponent further says that the said testimony of J. B. Moinier before refer'ed to, taken in France and put in on said reference before said master, sets forth the results of a series of experiments made in France in the year 1854–5 by the complainant in this cause and his brother and agent, B. C. Tilghman, to decompose fats according to the process described in said letters-patent of said complainant; that such experiments and efforts were wholly unsuccessful, and conclusively prove that fats can not be decomposed according to the process described in complainant's said patent; that said testimony of said Moinier is set forth in full in the printed record before refer'ed to, (pages 1 to 71,) to which, for greater certainty, deponents hereby refers.

Deponent further says that the impracticability of complainant's said invention is also shown by the testimony of C. H. Grant, a witness examined on said reference, and whose testimony is found in said printed record, on pages 147 to 171, to which reference is also made.

Deponent further says, as he is informed and believes, that, in
101 the year 1856, Thomas Emery & Sons, of Cincin'ati, Ohio, candle-manufacturers, addressed to the complainant in this suit a communication as to his said patented process, enquiring whether the same had been put in practice, etc., and that, in reply to such inquiries, said complainant sent to said Emery & Sons a letter, of which the following is a copy, (the original or a copy of which said letter was produced and put in evidence by said complainant in said suit brought by said complainant in Ohio against Michael Werk and others, in 1868, and before refer'ed to.)

(Copy.)

14 SOUTHAMPTON PLACE, EUSTON SQUARE,
London, June 25th, 1865.

THOMAS ENERY & SON, *Cincinnati.*

GENTLEMEN: I have received from Mr. Davenport your favor of 30th May last. Our experiments in the factories here and in Paris have shown that, on the large scale, the decomposition of fats by water is more conveniently effected by modifying the apparatus originally proposed, so that the fat and water are exposed to a comparatively lower heat and pressure for a longer time, instead of a very high pressure for a few minutes, and a considerable quantity of material is treated at one charge in an ordinary steam boiler lined with lead or copper
102 and provided with an agitator in place of using the continuously-working pumps and coil of pipes. At a pressure of 225 pounds per inch tallow, or palm-oil, or lard-stearine is completely decomposed in five hours. In the course of a few mounths we shall probably have going on at Price & Co.'s works an apparatus on the above plan, capable of treating several tons per day. Untill my process is in actual use in England, I have decided not to begin its introduction into the United States, and therefore cannot at present reply to your request as to terms of sale. As soon as it is well established here, I intend returning home, and will immediately communicate with you. I give below answers to such of your questions as I have materials for, and remain—

Verry respectfully, yours,

R. A. TILGHMAN.

Answers to questions.

1. The process is not practically at work on the large scale; but Price

& Co., of London, and the Companie Generale de Stearinerie, Moinier & Co., La Villette, Paris, are engaged in experiments preparatory to starting it.

2. The process is applicable to all sorts of fats and oils, vegetable or animal, hard or soft.

103 3. There is no other waste than the dirt and glycerine.

4. From 100 pounds clean, dry tallow we obtain 97½ pounds fat acids and eight pounds of concentrated glycerine.

5. The color of the product depends upon that of the original material. Palm-oil product is of a light gray color; tallow and stearine are somewhat whiter than the same material would produce by lime saponification.

6. In this respect the product resembles that from lime saponification of the same materials.

7. Yes; hot and cold pressing—just like saponified stuff.

8. Hydraulic presses are used. The product is more crystalline, and presses better than saponified stuff.

9. The danger is no greater than in working ordinary steam-boilers.

10. Answered in No. 9.

11. The apparatus is of ordinary boiler and coppersmith work, and the cost can be calculated by any one in those trades.

12. There is no more *were* than in the ordinary lead or copper-lined tubs.

13. A boiler forty feet long by thirty-two inches diameter, at
104 225 pounds per inch, would decompose 4,500 pounds in six hours.

14. Tallow and good stearine give by pressing a perfectly white product. Palm-oil or dark fat would require to be distilled after going through the apparatus.

15. For good white material like tallow, or good lard stearine, the lime saponification process is the best; for cheap, dark stuff like palm-oil, grease, lard, stearine, &c., the sulphuric distillation is preferable. In France they generally use both processes in the same factory—saponification for white, distillation for dark material. To distill white fats would not be economical, as the waste by tar, &c., would more than balance the saving by acids.

16. ——

17. The same product as from perfectly decomposed saponified stuff.

18. There is no offensive smell.

19. ——

R. G. MITCHELL

Subscribed & sworn to before me this 5th day of May, 1871.

A. T. GURLITZ,
Notary Public.

105 Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

SOUTHERN DISTRICT OF NEW YORK,
City and County of New York, ss:

Roland G. Mitchell, the above-named defendant, being duly sworn, deposes and says that he was present at the argument in this cause on

exceptions to the master's report therein, held at Newport, R. I., on the 7th and 8th days of July, inst., and that he heard read the affidavit of R. A. Tilghman, then made and read, as to the statement made by said Tilghman to this defendant, and set forth by defendant on his examination in this cause at New York, on the 12th day of December, 1867, and which statement is on page 133 of the printed record in the answer to the 23rd interrogatory.

Deponent further says that he has again carefully read his said answer, as contained in deponent's said examination, as to said Tilghman's statement made to deponent at the time referred to, with respect to his, said Tilghman's, invention; and deponent says that said statement, as set forth in deponent's said answer, is, in all respects true, and
106 that said Tilghman, at that time, made no reference to the coil-apparatus, as sworn to by said Tilghman in his affidavit made on the said 7th and 8th July, inst.; that said Tilghman's statement was made to deponent in reply to deponent's inquiry, "Why did you require your vessel to be kept full?" and the reply was, "As glycerine was more volatile than the fat acids acroleine would not so readily form if the glycerine was kept in solution," and that nothing was said by said Tilghman as to any particular form of apparatus.

R. G. MITCHELL.

Subscribed and sworn to before me this 14th day of July, 1871.
[L. S.] A. T. GURLITZ,
Notary Public.

(Endorsed:) U. S. circuit court, so. dist. N. York. R. A. Tilghman v. R. G. Mitchell. Aff't of R. G. Mitchell. Mo. for inj. S. D. Law, def't's sol'r. Filed July 14, 1871.

107 At a stated term of the circuit court of the United States of America for the southern district of New York, in the second circuit, held at the United States court-rooms in the city of New York, on Wednesday, the 13th day of September, in the year of our Lord one thousand eight hundred and seventy-one.

Present, the honorable Samuel Blatchford, dist. judge.

RICHARD A. TILGHMAN }
vs.
ROLAND G. MITCHELL. }

This cause came on to be heard upon motion for special injunction, and the plaintiff having been heard by George Harding, and the defendant, by Charles M. Keller and S. D. Law, esq.: Now, upon reading and filing the notice of motion and the affidavits annexed to the bill of complaint on behalf of the plaintiff, and also the affidavits and papers on file in opposition to said motion, it is ordered, adjudged, and decreed that, unless the defendant in this case accept and execute a license, duly executed by the plaintiff in the usual form, within ten days from the date hereof, under his extended letters-patent, an injunction shall
108 issue in this cause, as prayed for in the bill of complaint, until the further order of the court.

SAM'L BLATCHFORD.

(Endo.:) U. S. circuit court, S. D. of N. Y. Richard A. Tilghman v. Roland G. Mitchell. Order for injunction. Filed Sept. 13, 1871.

109 In the circuit court of the United States, in and for the southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK. } In equity.

To the honorable the judges of the circuit court of the United States in and for the southern district of Ohio:

Richard A. Tilghman, of Philadelphia, in the State of Pennsylvania, and a citizen of said State, brings this bill against Michael Werk, of Cincinnati, in the State of Ohio, and a citizen of the southern district thereof.

And thereupon your orator complains and says that, on or before the 9th day of January, 1854, one Richard A. Tilghman, was the true, original, and first inventor of a certain new and useful improvement in processes for purifying fatty bodies, not known or used before, and not, at the time of his application for a patent, in public use or on sale with his consent or allowance.

And your orator further shows unto your honors that the said Richard A. Tilghman, so being the inventor of said improvement, and being a citizen of the United States aforesaid, made application to the proper Department of the Government of the United States for letters-patent, in accordance with the then existing laws of Congress, and,

110 having duly complied in all respects with the conditions and requisitions of said laws, on the 3d day of October, 1854, letters-patent of the United States, signed, sealed, and executed in due form of law, for his invention or discovery, were issued to the aforesaid Richard A. Tilghman, whereby there were secured to him, his heirs, executors and assigns, for the term of 14 years, from 9th day of January, 1854, the full and exclusive right of making, using, and vending to others, to be used, the said improvement.

And your orator further shows that a description or specification of the aforesaid improvement was given in the schedule to the said last-mentioned letters-patent annexed, accompanied by certain drawings, referred to in said last-mentioned schedule, and forming part of said last-mentioned letters-patent. That the said last-mentioned letters-patent, and the said specification thereto annexed, (which, or an exemplified copy of which, your orator will produce, as your honors may direct,) were duly recorded in the Patent-Office, a copy of which is hereto annexed, marked "A."

And your orator further shows that your orator has extensively applied the said improvements to practical use, and has been, and, but for the infringement hereinafter complained of, would still be, in the undisturbed possession, use, and enjoyment of the exclusive privileges secured by the said letters-patent, and in receipt of the profits of the same.

And your orator further shows unto your honors, as he is informed and believes, that the said defendant hereinafter named, well knowing all the facts hereinbefore set forth, is now constructing and using the said patented improvement, in some parts thereof substantially the same in construction and operation as in the said letters-patent mentioned, the exclusive right and privilege to make and use which, and vend the same to others to be used, is thus by law vested in your orator.

And so it is, may it please your honors, that the said defendant, as

your orator is informed and believes, without the license of your orator, against his will, and in violation of his rights, has made and used, and intends to continue still to make and use, the said improvement within the southern district of Ohio, all of which is in violation of the said letters-patent and assignments.

To the end, therefore, that the defendant may, if he can, show reason why your orator should not have the relief hereby prayed, and that he may make a full disclosure and discovery of all the matters aforesaid, and upon his several corporal oaths, and according to the best and utmost of his knowledge, remembrance, information and belief, full, true, direct and perfect answer make to such of the several interrogatories hereinafter numbered and set forth, as by the note hereunder written required to answer; that is to say—

111 1. Whether the said original letters patent were granted and issued to the said Richard A. Tilghman, on the 3d October, 1854.

2. Whether the said defendant, has at any time, and if so, when and during what period of time, manufactured any fat acid and glycerine, from fatty bodies, by the action of water at a high temperature and pressure.

3. State minutely and in detail the process pursued by the defendant in the manufacture of fat acids and glycerine.

And now, to the end that the defendant may be compelled to account for and pay over the income thus unlawfully derived, from the violation of the rights of your orator as above, and be restrained from any further violation of said rights, your orator prays that your honors may grant a writ of injunction, restraining the defendant from any further construction or sale, or use in any manner of said patented improvement, or any part thereof, in violation of the rights of your orator as aforesaid, and that the machine or machines now in possession or use of the said defendant may be destroyed, or delivered up to your orator for that purpose. And your orator prays for such other relief as the equity of the case may require, and to your honors may seem meet.

May it please your honors to grant unto your orator not only a writ of injunction conformable to the prayer of this bill, but also a writ of subpœna of the United States of America, directed to the said Michael Werk, and commanding him to appear and answer unto this bill of complaint, and to abide and perform such order and decree in the premises as to the court shall seem meet, and be required by the principles of equity and good conscience.

GEORGE HARDING,
Solicitor for Complainant.

The defendant is required to answer each of the foregoing interrogatories numbered one to three, inclusive.

GEORGE HARDING,
Solicitor for Complainant.

On the day of A. D. , before the subscriber, came Richard A Tilghman, the complainant in the foregoing bill named, who, being duly sworn, says that, so far as the statements therein contained are within his own knowledge, they are true, and, so far as they are derived from the information of others, he verily believes them to be true. And he further says, that he verily believes the said Richard A. Tilghman, in said bill named, is the original, true, and first inventor of the new and useful improvement in processes for purifying fatty bodies, which is described in the letters patent granted to Richard

112 A. Tilghman, and mentioned in the foregoing bill. And your deponent verily believes that the title of him, the complainant, as set forth in said bill, is true.

R. A. TILGHMAN.

Sworn and subscribed before me—

J. BURCHARD,
U. S. Commissioner.

EXHIBIT A.

No. 11766.

The United States of America, to all to whom these letters-patent shall come:

Whereas, Richard A. Tilghman, of Philadelphia, Pa., has alleged that he has invented a new and useful improvement in processes for purifying fatty bodies which he states has not been known or used before his application; has made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said improvement, and that the same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the Treasury of the United States the sum of thirty dollars, and presented a petition to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said improvemen's, and praying that a patent may be granted for that purpose: These are, therefore, to grant, according to law, to the said Richard A. Tilghman, his heirs, administrators, or assigns, for the term of fourteen years from the ninth day of January, one thousand eight hundred and fifty-four, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvement, a description whereof is given in the words of the said Tilghman, in the schedule hereunto annexed, and is made part of these presents.

In testimony whereof, I have caused these letters to be made patent, and the seal of the Patent-Office has been hereunto affixed.

Given under my hand at the city of Washington, this third day of October, in the year of our Lord, one thousand eight hundred and fifty-four, and of the Independence of the United States of America, the seventy-ninth.

ROBERT McCLELLAND,
Secretary of the Interior.

Countersigned and sealed with the seal of the Patent-Office.
[SEAL.]

C. MASON,
Commissioner of Patents.

113 The schedule referred to in these letters-patent and making part of the same.

To all whom it may concern:

Be it known that I, Richard Albert Tilghman, of Philadelphia, have invented a new and improved mode of treating fatty and oily bodies, and I hereby declare that the following is a full and exact description thereof.

My invention consists of a process for producing free fat acids and solution of glycerine, from those fatty and oily bodies of animal and

vegetable origin which contain glycerine as their base. For this purpose I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fatty acids and solution of glycerine. I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting point of lead, until the operation is complete. The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

The process may be performed more rapidly and also continuously, by causing the mixture of fatty matter and water to pass through a tube or continuous channel, heated to the temperature already mentioned, the requisite pressure for preventing the conversion of water into steam being applied during the process, and this, I believe, is the best mode of carrying my invention into effect.

In the drawing hereunto annexed, are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention.

Fig. 1 of the said drawing is a vertical section of this apparatus, and Figure 2 shows the various parts of the apparatus in horizontal section; similar parts in those figures being marked with similar letters of reference.

I place the fat or oil in a fluid state in the vessel *a*, with from one-third to one-half its bulk of warm water. The disc or piston *b*, perforated with numerous small holes, being kept in rapid motion, up and down, in the vessel *a*, causes the fat or oil and water to form an emulsion, or intimate mechanical mixture. A force-pump *c*, like those in common use for hydraulic presses, then drives the mixture through a long coil of very strong iron tube *d d d d*, which, being placed in the furnace *e e*, is heated by a fire *f* to about the temperature of melting lead. From the exit end *g* of the heating tubes *d d*, the mixture which has them become converted into free fat acids, and solu-
114 tion of glycerine passes on through another coiled iron tube *h h h* immersed in water, by which it is cooled down from its high temperature to below 212° Fa'renheit, after which it makes its escape through the exit-valve *i* into the receiving vessel.

The iron tubes I have employed and found to be convenient for this purpose, are about one inch external diameter, and about half an inch internal diameter, being such as are in common use for Perkins' hot-water apparatus. The ends of the tubes are joined together by welding to make the requisite length, but where welding is not practicable, I employ the kind of joints used for Perkins' hot-water apparatus, which are now well known. The heating-tube *d d d* is coiled several times backwards and forwards, so as to arrange a considerable length of tube in a moderate space. The different coils of the tube are kept about a quarter of an inch apart from each other, and the interval between them is filled up solid with cast-iron, which also covers the outer coils, or rows of tubes to the thickness of half or three-quarters of an inch, as shown in Fig. 2. This casing of metal insures a considerable uniformity of temperature in the different parts of the coil, adding also to its strength, and protecting it from injury by the fire.

The exit-valve *i* is so loaded that, when the heating-tubes *d d d* are at the desired working temperature, and the pump *c* is not in action, it will not be opened by the internal pressure produced by the applica-

tion of heat to the mixture; and, therefore, when the pump *c* is not in action, nothing escapes from the valve *i*, if the temperature be not too high. But when the pump forces fresh mixture into one end *j* of the heating-tubes *d d d* the exit-valve *i* is thereby forced open to allow an equal amount of the mixture, which has been operated upon, to escape out of the cooling tubes *h h* at the other end of the apparatus. No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture. For this purpose, whenever it may be required, the speed of the pump should be increased, so that the current through the tubes may be made sufficiently rapid to carry out with it any air remaining in them.

Although the decomposition of the neutral fats by water takes place with greater quickness at the proper heat, yet I prefer that the pump *c* should be worked at such a rate in proportion to the length or capacity of the heating tubes *d d d*, that the mixture, while flowing through them, should be maintained at a desired temperature for ten minutes before it passes into the refrigerator or cooling parts *h h* of the apparatus.

The melting point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matters into fat acid and glycerine takes place with some materials, (such as palm-oil,) at or below the melting point of bismuth; yet the heat has been carried considerably above the melting point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat, and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed can easily be determined.

To indicate the temperature of the tubes *d d d*, I have found the successive melting of metals and other substances of different and known degrees of fusibility to be convenient in practice; several holes, half an inch in diameter and two or three inches deep, are bored into the solid parts of the casting surrounding the tubes, each hole being charged with a different substance. The series I have used consist of tin, melting about 440° F.; bismuth, at about 510° F.; lead, at about 612° F.; and nitrate of potash, at about 660° F. A straight piece of iron wire passing through the side of the furnace to the bottom of each of the holes, enables the workman to feel which of the substances are melted, and to regulate the fire accordingly. It is important, for the quickness and perfection of the decomposition, that the oil and water, during their entire passage through the heating-tubes, should remain in the same state of intimate mixture in which they enter them. I, therefore, prefer to place the series of heating-tubes in a vertical position, so that any partial separation which may take place while the liquids pass up one tube, may be counteracted as they pass down the next. I believe that it will be found useful to fix at intervals, in the heating-tubes, diaphragms pierced with numerous small holes, so that the liquids, being forced through these obstructions with great velocity, may be thoroughly mixed together.

I deem it prudent to test the strength of the apparatus by a pressure of ten thousand pounds to the square inch, before taking it into use: but I believe that the working pressure necessary, in using the heat I have mentioned, will not be found to exceed two thousand pounds to the square inch.

When it is desired to diminish the contact of the liquids with iron the

tubes or channels of the apparatus may be lined with copper. The hot mixture of fat acids, and solution of glycerine, which escapes from the exit-valve of the apparatus, separates by subsidence. The fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means.

The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soaps, and applied to various purposes according to their quality; and when desired they may also be first bleached by chemical agents, or purified by distillation, in a current of steam, or in a vacuum, as is now well understood. I prefer that the fatty bodies should be previously deprived, as far as practicable, of such impurities as would cause the discoloration
116 of the fat acids produced; but when the fat acids are to be finally purified by distillation, this preliminary purification is of less importance.

When the sulphuric acid, nitrous fumes, or other corrosive agent, shall have been used for purifying, hardening, or otherwise preparing the fatty body to be operated upon, I take care that all traces of it shall be washed out, or neutralized, before passing it through the apparatus.

Some fatty bodies (particularly when impure) generate, during the process, a portion of acetic or other soluble acid, which might tend to injure the iron tubes. In such cases I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes.

Having now described the nature of my said invention, and the manner of performing the same, I hereby declare that I claim, as of my invention, the manufacturing of fat-acids and glycerine from fatty bodies by the action of water at a high temperature and pressure.

R. A. TILGHMAN.

Witnesses:
JAMES MCCURLEY.
JOHN R. DARKER,
Consulate of the United States, London.

(Here follows diagram marked page 117.)

Seventh circuit court of the United States for the southern district of Ohio.

MICHAEL WERK
ads.
RICHARD A. TILGHMAN

And the said defendant comes, and for answer to the complainant's bill, says he believes it is true that said complainant did obtain a patent from the United States, as set forth in his said petition, and the copy of said patent attached thereto. But this defendant does not admit the said plaintiff was the original and first inventor of a new and useful process for producing free fat acids and solution of glycerine, from those fatty and oily bodies of animal and vegetable origin which contain glycerine as their base. On the contrary, he claims that the process of obtaining free fat acids and solution of glycerine from fatty and oily bodies of animal and vegetable origin containing glycerine as their base, was described in a public work called A. Payen's Chemistry, at page 766, which said work was published in Paris, France, by L.

Hackett & Co., in the year 1851. He also says that the production of fat acids by heat is described in a public work, called M. V. Regnault's Chemistry, in the 4th vol., page 414, section 1653 of that work,
119 which was published by Cha's Lahure, Paris, in France, in the year 1853. And, for further answer, the defendant says that, although it may be possible, by subjecting fat or oily bodies to the action of water at a high temperature to cause those fatty bodies to set the glycerine free, and thereby obtain free fat acids, yet he denies that it can be done so as to make it practicable and profitable, or economical to those who desire to use it. In the first place, in order to obtain the necessary heat to separate the constituent parts of those fatty or oily bodies, the metallic tanks and pipes used in the production of the acids are by the high degree of heat soon injured and destroyed, and by reason thereof the costs of manufacturing or obtaining free fat acids and glycerine by the action of heat and water only, is so much increased that the process cannot be practically carried on and made useful. In the second place the length of time required for the production of free fat acids and glycerine from oily and fatty bodies by the use of pressure, heat, and water, as described in the complainant's patent, is so great that in a practical and economical view of the question the said process cannot be made useful. The defendant denies that he is using or has been using the improvement patented to the plaintiff, or any part thereof, operating the same as is described in the plaintiff's patent. And the defendant, for further answer, says that the mode adopted by the manufacturers in treating fatty and oily substances, so as to produce the free fat acids and solution of glycerine up to within a few years past, was to heat the fatty substances in an open or close vessel, and, by the mixture of 14 pounds of lime and a certain quantity of water to 100 pounds of fatty and oily substance produce a lime-soap, and afterwards the lime-soap is decomposed with about 36 pounds of sulphuric acid to the 14 lbs. of lime, which acid combines with the lime in the presence of water, and frees the fat acids. This mode of obtaining the free fat acids in the manufacture of stearic acid, has been used by this defendant at his factory on Poplar st., between Western Row and John st., ever since the year 1841, known as the factory of M. Werk & Co., in the city of Cincinnati, State of Ohio. It has been used in the factory of Gross & Dietrick, on Western Row, between Poplar and Livingston st., ever since the year 1843, in the city of Cincinnati, State of Ohio. It has been used in the stearic-acid candle and soap factory of Proctor & Gamble, on Western Row, between York st. and Dayton st., in the city of Cincinnati, State of Ohio, since the year 1849. It has been used at the stearic-acid candle factory of Dennis & Shillito, situated on the Miami Canal, in the city of Cincinnati, State of Ohio, since the year 1847. It has also been in common use among many of the manufacturers in the city of Cincinnati, and in other cities of the United States.

Being anxious to effect the same object in a more expeditious and more economical manner, this defendant succeeded in inventing a combination of machinery or an improvement in apparatus for manufacturing fatty acids, consisting of a boiler in which to generate steam, a
set of metallic tubes placed in a furnace, by the heat of which
120 the steam passing through the tubes from the boiler is superheated, and passes into a tight tank, into which the mass of oil or other fatty substances are placed, and by these means the fatty acids are produced without distillation, or the direct application of fire. And for which invention and combination as aforesaid he obtained a patent from the United States, bearing date 5th October, 185[illegible].

And, in answer to the second interrogatory propounded to him by the complainant, he says he has not at any time manufactured any fat acid and glycerine from fatty bodies by the action of water at a high temperature under pressure.

And, for answer to the third interrogatory propounded, he says the process by which he manufactures fat acids and glycerine, is as follows:

He places his fatty substances in a common tank, closed on the top, so as to retain the heat and steam, with a mixture of from 6 to 7 pounds of lime and about 130 lbs. water to each 100 lbs. of fatty substances. Into these substances, so mixed as aforesaid, he introduces a sufficient quantity of superheated steam, heated to 340° to 350° Far., which, in connection with the action of the lime and water, produces a lime-soap, and sets the glycerine free in about five hours after the operation is begun. This lime-soap is afterwards decomposed by two and one-quarter pounds of sulphuric acid to each pound of lime used, and the fat acids become free. He further says that, for the last nineteen years, until he obtained his patent aforesaid, he has been carrying on the stearic-candle manufacturing business in the city of Cincinnati, and during all that time has been in the constant habit of manufacturing his fat acids by using 14 lbs. of lime, water, and about 36 lbs. of sulphuric acid to each 100 lbs. of fatty substances, and, since obtaining his patent combining the steam-boiler, pipes, and furnace for superheating the steam, with the tank aforesaid, he has manufactured his fatty acids from fatty substances in the manner before described, and in no other way whatsoever.

And the said defendant, in further answering, says that he is not aware that the plaintiff has practically succeeded in using, himself, or in inducing others to use his said patented process or improvement in obtaining fat acids and glycerine from fatty and oily bodies, by the action of water at a high temperature and pressure, and therefore cannot admit the same. On the contrary he, the plaintiff, has been unable to put the same into practical use, and therefore defendant requires proof of such use if any can be produced. He does not believe any such results have been or can be produced from the mere action of water at a high temperature and pressure, so as to be usefully and economically ap-
121 plied by manufacturers. The defendant denies the right of complainant to the relief prayed; and, having answered, he prays to be hence dismissed.

STATE OF OHIO, *Hamilton County:*

Michael Werk, the above defendant, being sworn, says the facts stated in the foregoing answer, so far as stated from his own knowledge, are true, and, so far as stated from the information of others, he believes them to be true.

(Signed) M. WERK.

Sworn to before me and subscribed in my presence, by Michael Werk, this 6th day of Jan'y, 1860.

[NOTARIAL SEAL.] CHARLES H. FOX,
Notary Public.

EXHIBIT B.

The United States Patent Office to all persons to whom these presents shall come, greeting:

This is to certify that the annexed are true copies from the files and records of this office of the papers in the application of M. Werk,

patented October 5, 1858, the copies of the specifications showing the erasure , interlelineations, and marginal writing in pencil, as they appear in the originals.

In testimony whereof I, W. D. Bishop, commissioner of patents, have caused the seal of the Patent-Office, to be hereunto affixed this (SEAL OF THE) 18th day of November, in the year of our Lord (PATENT-OFFICE.) one thousand eight hundred and fifty-nine, and of the Independence of the United States the eighty-fourth.

WM. D. BISHOP.

Petition.

To the Commissioner of Patents:

The petition of M. Werk, of Cincinnati, in the county of Hamilton, and State of Ohio, respectfully represents—

That your petitioner has invented a new and improved process of manufacturing fat acids, which he verily believes has not been
122 known or used prior to the invention thereof by your petitioner.

He therefore prays that letters-patent of the United States may be granted to him therefor, vesting in him and his legal representatives the exclusive right to the same, upon the terms and conditions expressed in the act of Congress, in that case made and provided, he having paid thirty dollars into the Treasury, and otherwise complied with the requirements of said act. And he hereby authorizes O. D. Munn, S. H. Wales, and A. E. Beach, of the firm of Munn & Co., or their accredited agents, to act as his attorneys in presenting the application, and in making all such alterations and amendments as may be required.

M. WERK.

Oath.

COUNTY OF HAMILTON, *State of Ohio, ss:*

On this 7th day of May, 1858, before the subscriber, a justice of the peace in and for said county, personally appeared the within-named M. Werk, and made solemn oath that he verily believes himself to be the original and first inventor of the within-described improved process of manufacturing fat acids, and that he does not know or believe that the same was ever before known or used, and that he is a citizen of the United States.

M. WERK.

Sworn to and subscribed before me, at Cincinnati, May 7, 1858.

C. F. HANSELMAN,
Justice of the Peace.

To all whom it may concern:

Be it known that I, M. Werk, of the city of Cincinnati, in the county of Hamiltion, and State of Ohio, have invented a new and improved process of manufacturing fat acids, and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, making a part of this specification, in which—

Fig. 1 is an elevation of the apparatus employed in performing my invention.

Fig. 2 is a plan of the same.

Similar letters of reference indicate corresponding parts in both figures.

123 My invention is based upon the discovery I have made, that fatty or oleaginous bodies, when subjected directly to the action of superheated steam, are decomposed into free fat acids and glycerine; and my invention consists in the practical application of this discovery.

To enable others to make and use my invention, I will proceed to describe the manner in which it is performed, and the apparatus I employ in the process, represented in the drawing.

The fatty or oleaginous body to be treated is placed in a strong, close vessel, into which the superheated steam is admitted, and in which the latter is allowed to act upon the body for a suitable length of time, which may be determined by practice or by tapping the vessel from time to time to analyze the contents. The superheated steam alone, of a temperature of from 806° to 900° Fahrenheit, will effect the decomposition, but acids or alkalies may be used in combination with the superheated steam, to render so high a temperature unnecessary; and I find by experiment that, by using about 7 pounds of lime and 50 pounds of water, in the form of milk of lime, for every 100 lbs. of fatty or oleaginous matter, a temperature of from 400° F. to 530° F. will be sufficient for the superheated steam.

In the accompanying drawing, D is the vessel in which the decomposition is effected, furnished with a cock, L, near the top, to admit the body to be treated, which should be first melted. A is a boiler for generating steam, and B is a superheating furnace, containing a coil, C, to which the steam pipe E from the boiler is connected, and from which a pipe, F, leads to the vessel D and circulates within the vessel in the form of a coil, which is perforated to admit the steam in numerous small streams.

The operation, as generally conducted in the said apparatus, is as follows: The tank is filled to a suitable height through the cock L, while the pipes E and F are closed by cocks provided for that purpose; then, before the fire is lighted in the superheating furnace B, steam is admitted from the boiler to the vessel D which is kept at a temperature of about 212° F. for about from 15 to 20 minutes; and then the milk of lime, if used, is introduced through the cock L or another cock provided for that purpose. The cock is then closed, and the fire lighted in the furnace B, to superheat the steam, and the contents of the vessel D are subjected to the action of the steam for about from 3 to 5 hours. The contents of the vessel D are drawn through a cock, M, at or near the bottom, after the decomposition is complete.

The heat required for the superheated steam will be greater in proportion as less lime is used.

124 The advantage of the use of superheated steam, as above described, in the decomposition of fatty or oleaginous bodies, consists principally in obviating the danger of burning the vessel or its contents, which danger always exists when the decomposing vessel is subjected to the direct action of fire.

What I claim as my invention, and desire to secure by letters-patent, is:

The manufacture of fat acids by subjecting fatty or oleaginous bodies

to the direct action of superheated steam, either with or without the use of other agents, substantially as herein described.

M. WERK.

Witnesses:
C. F. HANSELMANN,
W. F. HANSELMANN.

U. S. PATENT-OFFICE,
June 26, 1858.

SIR: Your application for a patent for an improved treatment of fatty acids, has been examined. You are referred to Regnault's Chemistry, vol. 2, paragraph 1594, to Payne's Chemie Industrielle, p. 771, and to the patents of R. A. Tilghman, January, 1855, and October, 1854. Mr. T. is the acknowledged discoverer of this process. The application is refused for want of novelty.

Respectfully, yours, &c.,

J. HOLT, *Commissioner.*

M. WERK, Esq.,
(Care of Munn & Co., New York.)

WASHINGTON, *Sept.* 15*th*, 1858.

Hon. J. HOLT,
Commissioner of Patents.

SIR: I have discontinued of having Messrs. Munn & Co. as my agents in a patent claim being before you for the production of fatty acids, and take the liberty to request your honor to return me my papers in this case, for which you will oblige your most obedient servant,

M. WERK.

125 WASHINGTON, *Sept.* 15*th*, 1858.

Hon. J. HOLT,
Commissioner of Patents.

SIR: I hereby beg leave to amend my application for a patent for improvement in treatment of fatty acids by renewing all of the specifications preceding the names at the close and inserting in place thereof the following amendment, and request a reconsideration of the case.

Respectfully, yours,

M. WERK.

To all whom it may concern:

Be it known that I, M. Werk, of the city of Cincinnati, in the county of Hamilton, and State of Ohio, have invented a new and improved process of manufacturing fat acids, and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, making a part of this specification, in which—

Fig. 1 is an elevation of the apparatus employed in performing my invention.

Fig. 2 is a plan of the same.

Similar letters of reference indicate corresponding parts in both figures.

To enable others to make and use my invention, I will proceed to de-

scribe the manner in which it is performed, and the apparatus I employ in the process represented in the drawing.

The fatty or oleaginous body to be treated is placed in a strong close vessel, into which the superheated steam is admitted, and in which the latter is allowed to act upon the body for a suitable length of time, which may be determined by practice or by tapping the vessel from time to time to analyze the contents. The superheated steam alone, of a temperature of from 800° to 900° Fahrenheit, will effect the decomposition, but acids or alkalies may be used in combination with the superheated steam to render so high a temperature unnecessary; and I find, by experiment, that, by using about 7 pounds of lime and 50 lbs. of water, in the form of milk of lime, for every 100 lbs. of fatty or oleaginous matter, a temperature of from 400° Fahrenheit to 530° F. will be sufficient for the superheated steam.

In the accompanying drawing, D is the vessel in which the decomposition is effected, furnished with a cock, L, near the top to admit the body to be treated, which should be first melted. A is a 126 boiler for generating steam, and B is a superheating furnace, containing a coil, C, to which the steam-pipe E from the boiler is connected, and from which a pipe, F, leads to the vessel D and circulates within the vessel in the form of a coil, which is perforated to admit the steam in numerous small streams.

The operation, as generally conducted in the said apparatus, is as follows:

The tank is filled to a suitable height through the cock L, while the pipes E and F are closed by cocks provided for that purpose; then, before the fire is lighted in the superheating furnace B, steam is admitted from the boiler to the vessel D, which is kept at a temperature of about 212° Fahrenheit for about 15 to 20 minutes, and then the milk of lime which is used is introduced through the cock L or another cock provided for that purpose. The cock is then closed and the fire lighted in the furnace B to superheat the steam, and the contents of the vessel D are subjected to the action of the steam for about from 3 to 5 hours. The contents of the vessel D are drawn through a cock, M, at or near the bottom after the decomposition is complete.

The heat required for the superheated steam will be greater in proportion as less lime is used.

This discovery depends in the fact that fatty or oily bodies, whether animal or vegetable, when mixed with other bodies and subjected to steam of high temperature, will combine with them and produce fat acids, and the nature of my invention consists in the combination and arrangement of the apparatus as herein set forth for the saponification of fatty bodies.

My plan is substantially the direct application of superheated steam to the mass of oil or other fatty substances, and thus producing fat acids without distillation or the direct application of fire.

I do not claim the use of the boiler as new, or the use of a furnace for superheating steam as new, nor yet the use of a tank as new; but what I claim as new is the combination of boiler, superheating furnace, and tank, for the production of fat acids without distillation or direct application of fire, as herein set forth.

M. WERK.

Attest:

JOHN S. HOLLINGSHEAD.

JOHN KIRBY.

(Here follows diagram, page 127.)

129 DISTRICT OF COLUMBIA,
County of Washington:

On this day, Sept. 15th, 1858, before me, the subscriber, a justice of the peace, personally appeared the within-named Michael Werk, and made solemn oath that he verily believes to be the original and first inventor of the mode herein described in an improved process for the production of fat acids, and that he does not know or believe the same was ever before known or used; and that he is a citizen of the United States.

JOHN S. HOLLINGSHEAD, *J. P.*

STATE OF OHIO:

Circuit court of U. S. in and for the southern district of Ohio.

RICHARD A. TILGHMAN }
vs.
MICHAEL WERK. }

The defendant will take notice that, on the 25th day of July, A. D. 1860, the plaintiff will take the depositions of sundry witnesses, to be used as evidence on the trial of the above cause, at the office of Charles F. Heazlitt, commissioner, No. 104 South Fifth street, in the city of Philadelphia, and State of Pennsylvania, before competent authority, between the hours of eight o'clock a. m. and six o'clock p. m., of said day, and that the taking of the same will be adjourned from day to day between the same hours until they are completed.

GEORGE HARDING,
Solicitor for Plaintiff, by B. C. T.

Service of the above notice is acknowledged, and proof of the official character of the officer before whom the said depositions may be taken is by agreement waived; also all exceptions in regard to time.

CHARLES FOX,
Attorney for Defendant.

UNITED STATES,
Eastern District of Pennsylvania, set:

Be it remembered that, on the twenty-fifth day of July, A. D. 1860, personally appeared at my office, U. S. courts, No. 104 South Fifth street, in the city of Philadelphia, before me, Charles F. Heazlitt, a commissioner appointed by the circuit court of the United States in
130 and for the eastern district of Pennsylvania, in the third circuit, under the laws of the United States, to take affidavits and acknowledgments of bail, &c., JAMES C. BOOTH, to testify and the truth to say on the part and behalf of the plaintiff, in a certain suit or matter of controversy now depending and undetermined in the circuit court of the United States in and for the southern district of Ohio, wherein Richard A. Tilghman is the plaintiff, and Michael Werk is the defendant.

And the said witness, being of lawful age, and having been by me first cautioned and sworn to testify the truth, the whole truth, and nothing but the truth in the matter and controversy aforesaid, did thereupon depose, testify, and say as follows, viz:

1. What is your name, age, residence, and occupation or profession?

My name is James C. Booth; aged 49 years; residence in the city of Philadelphia; by profession an analytical chemist, and melter and refiner in the United States mint in said city. I have followed said profession twenty-five years, and studied it in Germany.

2. What posts in public institutions have you held? And if you have written any works on chemical subjects state them.

I was professer of technical chemistry in the Franklin Institute for ten years; professor of natural philosophy and chemistry in the Philadelphia high school about two years. I was engaged in manufacturing chemistry for three years. I have been melter and refiner in the U. S. mint for the last ten years. I wrote the greater part of the Encyclopedia of Chemist'y; the Report on the Progress of Chemical Arts for the Smithsonian Institution; edited the American edition of Regnault's Chemistry. That is all I recollect. I don't speak of small essays.

3. Are you acquainted with the various processes used for manufacturing fat acids and glycerine in the arts?

I am acquainted with them from study and by experiment.

4. Have you read and do you understand the patent granted to plaintiff in this case, dated October 4th, 1854?

I have read it, and do understand it.

5. Have you read and do you understand the answer of the defendant in this suit, as contained in a certified copy now shown you?

I have read said answer, and do understand it.

6. Have you read and do you understand the patent of defendant, dated 5th of October, 1858, and referred to in said answer?

I have read said patent, and do understand it.

131 7. State whether the process of defendant, as set forth in his answer, is substantially the same, or different in principle and mode of operation from that described and claimed in said plaintiff's patent.

It is in princip*al* substantially the same.

8. Did you analyze an alleged specimen of the product of defendant's process? If aye, from whom and when did you receive it? and give your analysis of the same, fully and in detail.

I did analyze an alleged specimen of the product of defendant's process. I received it from Mr. B. C. Tilghman about the middle of June, 1860. The thoroughly-dried material yielded $56\frac{52}{100}$ per cent. lime-soap, $40\frac{47}{100}$ per cent. fat acids, and $3\frac{1}{100}$ per cent. glycerine. The analysis of $56\frac{52}{100}$ lime-soap gave $5\frac{21}{100}$ of lime; which is therefore the percentage of lime in the mixture.

9. Have you read and do you understand the passage in "A. Payne's Chemistry," p. 766, referred to in defendant's answer?

I have read, and do understand the same.

10. State whether the process described in Payne's Chemistry is substantially the same as that described in plaintiff's patent; and point out in detail wherein said processes resemble or differ from each other in principle or operation.

Those described in Payne's are different from that in Tilghman's patent, in principle and operation. Those in Payne's Chemistry refer to the distillation of fat acids by superheated steam, or steam of a high temperature, while Tilghman's patent separates fat acids and glycerine by the action of highly-heated water. Those described by Payne, wholly or chiefly destroy glycerine—the process in Tilghman's patent retains the glycerine; I mean saves it from destruction, more or less. Those in Payne refer to the distillation of fat acids; that in Tilghman's to the separation of fat acids and glycerine. Those in Payne do not propose to ob-

tain glycerine; that in Tilghman's obtains glycerine as a commercial product.

11. How do the processes agree, or differ, so far as concerns the use of pressure?

In Payne there is no allusion to pressure; in Tilghman's, pressure is essential.

12. Please state why pressure is essential in Tilghman's process.

Because, as Tilghman's process is to separate fats into fat acids and glycerine by means of water above its boiling point, the water can only be retained in that state by such pressure—by "that state," I
132 mean the liquid state—and not a state of steam; I consider steam and water as different things.

13. How do the two processes agree, or differ, so far as relates to the use of close vessels?

Because those in Payne speak exclusively of distillation of fat acids, therefore the vessel cannot be a close vessel in which such operation is performed. Tilghman's process requires a close vessel, for the reasons stated in my answer to the preceding question, (12.) Those in Payne require the vessel in which the operation is performed to have an opening in its upper part, through which the products of distillation may pass. As Tilghman's process does not consist in distillation, no such opening is required.

14. Have you read, and do you understand, the passage in E. Regnault's Chemistry, as follows:

(Which counsel for plaintiff states to be the extract referred to in defendant's answer, as the extract in the 4th volume, page 414, section 1653 of that work.)

§ 1594. "Les opèrations chimiques par lesquelles on transforme les matieres grasses naturelles en glycérine et en acides gras, portent le nom général de saponification. Elles sont de diverse nature; la saponification des graisses peut s' effectuer, en effet, soit par l' les alcalis soit par les acides énergiques, soit même par l' action seule de la chaleur.

Si l' on chauffe les graisses jusqu' á une température de 300°, dans un appareil que l' on fait traverser par un courant de vapeur d 'eau sous une pression plus faible que celle de l' atmosphere, la glycérine se détruit en plusieurs produits solubles dans l' eau, et les acides gras, devenus libres, distillent sans alteration; on a donc obtenu ainsi une saponification par la chaleur seule."

(Translation furnished by Mr. Booth, and referred to in answer to 16th interrogatory-in-chief.)

The chemical operations by which natural fatty matters are transformed into glycerine and fat acids, has the general name of saponification. They are of different kinds. Saponification of fat may be effected in fact, either by alkali, or by strong acids, or even by the action of heat alone. If the fats are heated to a temperature of 572° Fahrenheit, in an apparatus through which a current of steam is passed at a lower pressure than that of the atmosphere, the glycerine is destroyed, and converted into several products soluble in water, and the fat acids becoming free distil without change, thus saponification by heat alone has been attained.

I have read and understand said passage.

15. State whether the process set forth in said work is substantially the same as that described in plaintiff's patent, and point out in
133 detail wherein they resemble or differ from each other in principle or operation.

The process in Regnault is different from that in Tilghman's patent —different in principle and operation. Regnault's process passes steam through the fats heated to a temperature of 300° centigrade or 572° Fahrenheit, whereby glycerine is destroyed and the fat acids distilled over. Regnault's process is employed for the distillation of fat acids; and is therefore performed in vessels with an opening through which the products of distillation may pass. Tilghman's process heats the fats and water at a temperature above the boiling point of the water, whereby the fats are separated into fat acid and a solution of glycerine in the water employed. In Regnault's process the fat acids are distilled, and in Tilghman's they are not distilled. In Regnault's process, the glycerine is destroyed; in Tilghman's process, the glycerine is saved. In Regnault's process, the operation is performed without pressure, and in Tilghman's process, it is performed under pressure.

16. Please furnish to the commissioner a translation of the "French abstract from Regnault" referred to in the foregoing question.

I furnish you this translation which you can place underneath the extract.

17. Have you seen in any published works a description of processes for the manufacture of lime-soap and of common soap in close vessels under pressure? If aye, name the works, and describe the processes.

I have seen such works: In one of Roret's Encyclopædies, called "Acides Gras, Bougies Steariques," &c., at page 114, there is a patented process of Milly & Motard, patented in 1834, described in the Brevet of Invention, volume 52, page 505.

The process consists in putting into a boiler, a closed boiler, a quantity of suet, twice the quantity of water, and when the suet is melted, adding milk of lime sufficient to saponify the fats; the boiler is then closed, and heated, with frequent stirring of the contents, until the thermometer marks $276\frac{5}{10}$ Fahrenheit; it was then allowed to cool, and the lime-soap taken out.

There is another patent described in the Repertory of Patent Inventions, 2d series, vol. 11. p. 205, in which the saponifying process is performed in close or steam-tight vessels under steam pressure, and at temperatures exceeding the ordinary boiling points used when the same ingredients are heated in open vessels. The pressure from 50 to 70 pounds is expressed.

18. Please state how the process of Tilghman's patent compares with the processes referred to in your last answer.

134 In both the processes referred to in my last answer, the object is the complete saponification by lime in the French work, and the complete saponification by soda in the Repertory of Patent Inventions. Tilghman's process separates the fat into fat acids and glycerine, both of which are separately obtained. In saponification by lime or soda, in the processes referred to, the glycerine is lost for all practical purposes.

The French and English processes are for saponification by alkaline bases, which more or less completely combine with all the fat acids.

19. What is the nature of the chemical products formed, in the French and English works referred to?

They were soaps of lime and soda, respectively.

20. What is the nature of the chemical product formed in Tilghman's patent process?

Fat acids and glycerine are the products formed.

21. In the French and English processes referred to in your 19th answer, was there free fat acid produced?

I would suppose not a trace, certainly none of any amount.

22. Is there anything in any of the descriptions that would lead any one to suppose that free fat acid was produced or intended to be produced?

In the French process it is distinctly stated that fat acid could not be produced. In the English process there is nothing to lead one to suppose that a trace of that acid could be produced.

23. What would be the quantity of lime per 100 pounds of fat, requisite in practice to carry out the process described in the French work referred to in answer 19?

The quantity would be from 10 to 12 pounds of lime to every 100 pounds of fat.

24. From the knowledge obtained by you of the defendant's process, from the answer filed and the patent referred to therein, and your analysis of the alleged product of the defendant's process, please state minutely and in detail wherein the defendant's process embodies the features or principle of operation of plaintiff's patent?

In Tilghman's process, fat and water are heated together in a steam-tight vessel, above the boiling point of water, either without the use of lime, or with the use of from ½ to 1 pound of lime to 100 pounds of fat. In defendant's process, fat and water are likewise heated in a steam-tight vessel, by the use, according to my analysis of the product, of about 5 per cent. of lime—per cent. referring of course to 100
135 pounds of fat. In Tilghman's process, the vessel is heated by external heat; in the defendant's process, heat is transmitted into the interior, into the mixed water and fat, by superheated steam. In defendant's process, there is not a distillation of fat acid, because it is performed in a steam-tight vessel, under a pressure greater than that of air, and therefore the only object of superheated steam is to transmit heat into the interior of the vessel. In defendant's process about one half of the fat is saponified by lime, the other half is decomposed into fat acids and glycerine by the superheated steam introduced into the mixture of the water and fat acids in the vessel. In defendant's process, the object of introducing superheated steam under pressure, is to heat the water beyond its boiling point, and thus effect the same decomposition as is involved in Tilghman's process. In defendant's process, the usual method of saponification by lime is performed on about one-half of the fat, the other half is decomposed into fat acids and glycerine, by water, which is heated above its boiling point by superheated steam under pressure. This last half of the fat is therefore decomposed on the same principle as in Tilghman's process.

25. Please state whether or not the chemical agent in producing 50 per cent. of fat acid, in defendant's process, is water at a high temperature under pressure?

Yes, sir; it is.

26. So far as the production of that fat acid is concerned, does it make any difference whether superheated steam is employed as the agent for heating the water, or any other heating agent, such as steam direct from the boiler, or a fire placed below the tank?

The effect would be identical.

27. What is superheated steam, and what becomes of superheated steam on its introduction into defendant's tank?

Superheated steam is steam heated to a temperature beyond that of the steam in the boiler from which it originates. And on its introduc-

tion into defendant's tank, it becomes condensed into liquid water, transferring its heat to the mixture of fat and water in the tank.

28. What is the effect of heating water in a close vessel, allowing no escape for steam?

The pressure in the vessel will continually rise, with the continuing application of heat, and the temperature of the water will also rise in a certain proportion to every increase of 10-pound pressure.

29. Have you made any experiments to ascertain to what extent the temperature of water will be increased proportionably to the increase of pressure; and, if so, under what circumstances were these experiments made?

136 I have made such experiments, and they were made in order to the manufacture of fusable alloys, employed by the U. S. steamboat-inspectors, to prevent the explosion of steam-boilers. At the request of the Secretary of the Treasury, I made a series of such alloys, in 1853, which represented every ten-pounds pressure above the ordinary pressure of the air, up to 160-pounds pressure. There is a correspondence between those pressures and the temperatures at which those alloys melt. The first ten-pounds pressure above 212 indicate an increase of temperature of about 20°, more or less, the last ten-pounds pressure of the series, say from 150 to 160 pounds, are represented by 3 or 4° Fahrenheit increase of temperature; the last temperature wou be about 360° Fahrenheit.

30. In an ordinary steam-boiler, are the steam and the water at the same temperature?

They are.

31. Is it, or not, an inevitable law of nature or condition that water in a vessel at a temperature of 360° must be under a pressure of over 100 pounds, or, in other words, does not the presence of water in a liquid state with that temperature necessarily imply the presence of a pressure of over 100 pounds to keep it in that state?

Water at 360° must be under a pressure of over 100 pounds.

32. Is, or not, this correspondence of pressure and temperature a notorious fact in science, and has it not been so for many years?

The correspondence between pressure and temperature has been determined by commissions appointed by the French government, and by individuals of established reputation in France, England, Germany, and this country. The results of all these different observers closely coincide, and the greater part of these observations have been known for thirty years and upwards.

Cross-examined by Charles Fox, esq., for defendant:

33. Prior to the date of Mr. Tilghman's patent, please state the usual process of separating the glycerine from fatty substances; if by the aid of lime, state the quantity of lime used, and the object of its use; and how and in what way this lime was afterwards separated, so as to produce a free fat acid.

The usual mode of separating glycerine from fatty substances, prior to the date of the patent, was by the means of the oxide of lead; but I cannot speak from memory of the proportions employed; I do not know of any process of separating it by means of lime economically.

137 34. Where have you known it practically separated by oxide of lead?

I have read of it, and have performed the process, in an experimental way, in my own laboratory.

35. Please state whether Mr. Tilghman claims anything more in his

patent than the separating the glycerine from the fatty substances by heat and pressure alone, without the aid of lime or any other chemical substance? What is the degree of heat set out in his patent as necessary to produce such results?

Mr. Tilghman does not claim separating the glycerine from the fatty substances by heat and pressure alone, but he claims the separation of the glycerine from the fat acids, by water at a high temperature and pressure.

There is no specific temperature set out in his patent as necessary to produce decomposition of the fatty bodies. He states that he has obtained good results at the melting point of lead, which is above 600, and suggests that the temperature of decomposition should be ascertained by experiment, beginning at a low temperature and rising to a higher.

36. In what way does he claim to separate glycerine from fat acids other than by high temperature and pressure?

He claims to separate glycerine from fat acids in no other way than by water, at high temperature and pressure.

37. At what temperature, in your opinion, will the glycerine separate from fatty substances, so as to leave free fat acids?

My opinion, derived from reading, is that glycerine and fat acids may be separated from fats at a temperature of some 350, as well as I recollect.

38. State if you have had any practical knowledge on this subject. Have you ever seen fat acids separated from glycerine by such a heat as 350°?

No, sir; I have not witnessed the operation. I have no practical knowledge.

39. In referring to Regnault's Chemistry, I understand you to say his process is employed for describing the distilling the fat acids. Do you not understand the writer as referring to the different modes in use of separating glycerine from fatty substances, among which is that by heat alone? Does not what he says on the subject of distilling refer to distilling free fat acids?

138 Regnault rather refers to the separating of fat acids from fats than glycerine from fats, and speaks of one principle by heat alone. What he says on the subject refers to a decomposition of fats and distillation of fat acids simultaneously, but he nowhere refers to decomposition by water.

40. What substances are there in fatty matters, such as are used by ordinary manufacturers of candles, &c., other than the glycerine and the free fat acids; and is it not the great object to separate the glycerine from the other substances?

There might be trifling impurities in fats commonly used, but they could not be called constituents of the fats. The great object is to separate glycerine from the fat acids.

41. Is it your opinion that, by heat alone, glycerine can be separated from fatty substances so as to produce free fat acids?

Glycerine, as such, cannot be separated from fat acids by heat alone, but would be essentially altered or destroyed.

42. In separating the glycerine by the ordinary process of using lime in a boiler or tank, in which the fatty substance is contained, open at the top, how much lime is necessary for 100 pounds of fat; and how much sulphuric acid is necessary, afterwards, to separate each pound of lime?

Theoretically 10 to 12 pounds of lime would be sufficient, but prac-

tically about 14 pounds are employed, and two or two and a quarter pounds of oil of vitriol for every pound of dry lime.

43. You say, in your opinion, the principle of Mr. Tilghman's patent, and the process used by Mr. Werk are substantially the same. Does Mr. Werk claim to manufacture free fat acids by water and heat alone? Does Mr. Tilghman describe any lime as necessary in his process?

Mr. Werk does not claim to manufacture free fat acids by water and heat alone. Mr. Tilghman does not describe any lime as necessary in his process. Mr. Werk, although not claiming it, does actually manufacture about one-half of the acid obtained from fats by water at high temperature and pressure.

44. What amount of pressure would be produced by water heated to 600° to 630° Fahrenheit?

I cannot recollect the amount of pressure. My own tables only rise to a temperature corresponding to about 160-pounds pressure, or a temperature of 350° or 360° Fahrenheit.

139 45. Have you seen the plaintiff's process reduced to practice, any where? If so, where and for how long a time?

I have not seen it reduced to practice.

46. How long has the use of superheated steam been known? How long since water or steam has been used in tanks or boiler, at a heat of 500° or 600° Fahrenheit.

The use of superheated steam has been known for many years, for twenty years, for manufacturing purposes. I have not heard of water being used at such a temperature, until I heard of Tilghman's patent; I have known steam to be used at 2,000 atmosphere—supposed to be 2,000—in Perkins' steam-gun.

47. You say the tank used by Mr. Werk, you suppose to be steam-tight. Have you any knowledge of the manner in which his tank is constituted; whether or not there is a pipe on the top of his tank, for the escape of steam?

There are two openings on the top of Werk's tank, one for a safety-valve, and the other for the escape of steam, regulated by a valve. I refer to the certified copy of his patent, with the drawings annexed. When the valve is closed, the tank is steam-tight up to the amount of pressure allowed by the safety-valve.

48. Can you state more particularly in relation to the patent of Milly & Motard, described in the Encyclopedia Roret, above alluded to, by which the fat is saponified by the use of milk of lime and water, and the use of heat of $276\frac{8}{10}$. What is the pressure at that degree of heat? Where was that book published?

The pressure at that temperature is about 30 pounds. The book was published at Paris in 1849.

49. Please explain the difference between what you call distilling fatty substances, as spoken of by Regnault, and separating the glycerine by Mr. Tilghman's process. In distilling, is the glycerine carried off through the opening, with the fat acid, and afterwards freed; or how?

Regnault speaks of distilling fatty substances, and of the destruction of glycerine. When the fat acid is separated from it, the decomposed products of the glycerine are carried off through the opening, with the fat acid, and is therefore entirely lost. In Mr. Tilghman's process, the glycerine is obtained in solution in the water, and is sold as an article of commerce. The glycerine is destroyed in the act of separating from the fat acids, and therefore does not pass off with them as glycerine.

50. In what, then, does the one process as described in Milly &

Motard's patent, differ from the plaintiff's, except that the one
140 produces the effect of separation by the use of water and heat, and the other by use of water, heat, and milk of lime? Explain also, what is meant by milk of lime.

The difference is, that Milly & Motard's process requires sufficient lime to saponify the fat, and Tilghman's requires little or no lime. Milk of lime is a solution of lime in water, with finely powdered lime suspended in water. Milly & Motard's process makes lime-soap; Tilghman's process separates the fat into fat acids and glycerine, which is dissolved in the water, and is sold as a commercial product.

51. Is there not heated water used? Is there not a steam tight tank used, with pressure, by the Milly & Motard process, the same, although not in the same degree, as in the plaintiff's process?

Heated water and steam-tight tank are used, with pressure, in Milly & Motard's process; but not alone, for lime is used to saponify the fat in this process.

52. Are not all fatty substances saponified with lime, actually named lime-soap?

They are called lime-soap after saponification by lime.

53. If there is any lime left in the fatty substance, after the separation of the glycerine, do you call it free fat acid?

So much of it is free fat acid as cannot find a full equivalent of lime to combine with; in other words, as does not form a complete lime-soap.

Adjourned till to-morrow, 9 a. m.

THURSDAY, *26th July*, 1860.

Present, Mr. Harding, Mr. Fox.

The cross-examination of Professor Booth is proceeded with.

54. What proportion of lime can there remain in the fatty substance, without injuring the article as a merchantable article of free fat acid?

As far as I know, a mixture of fat acids and lime-soap is not a merchantable article, but becomes so by neutralizing the lime, and removing the salt of lime with that acid.

55. You have referred to the patent to Arthur Dunn for improvements in the manufacture of soap, described in the 11th vol., 2d ser., of
141 the Repertory of Patent Inventions. Is it not shown in that patent that he uses a covered steam-tight vessel, in order to boil the fats intended to be saponified, so that the saponifying process may be performed under steam pressure, and at temperatures exceeding the ordinary boiling points of the ingredients used? Please state the degrees of Fahrenheit he provides in his boiler or tank. Describe his tanks, whether he has a pipe for the escape of steam from the tank, and also a safety-valve on the top to let off steam when too high. If the fatty substances were put into Dunn's boiler or tank, containing water alone, would not the same heat and the same pressure be obtained on that boiler or tank as the boiler or tank used by Mr. Tilghman, or by any other person using a steam-tight boiler or tank?

In Dunn's process referred to, he uses a steam-tight vessel, and applies a temperature of 310° Fahrenheit in his tank, in order to form a soda-soap, and not free fat acids. It is a steam-tight tank with a pipe for the escape of steam, which is closed by a valve when in use, in order to raise the pressure and temperature in the interior; it is also provided with a safety-valve at the top to regulate that pressure. If the boiler

were of sufficient strength, and the safety-valve sufficiently loaded, the same heat and pressure could be obtained in Dunn's tank as in Tilghman's, or in any other tank similarly constructed.

56. Is your knowledge on the subject sufficient to say whether free fat acid can be made, as a merchantable article, for manufacturing stearic-acid candles by the application of heat and water merely, without distillation and without a base?

I know, from the testimony of several individuals, that free fat acid can be made by highly-heated water, without distillation and without a base. The testimony referred to, is that of several witnesses, whose depositions were taken in the present case in Cincinnati, and which I have read; and further, from the testimony of Mr. R. A. Tilghman, the plaintiff, and of Mr. B. C. Tilghman, his brother, delivered to me some four or five years since.

57. Have you sufficient knowledge to state how many hours it will take to reduce fatty substances into free fat acids by heat and water alone, and at what degree of heat, and how long to produce free fat acids by the use of steam in a tight vessel or tank, using about 6 to 7 pounds of lime to 100 pounds of fatty substance?

My only knowledge on this point, is derived from the depositions taken in the present case at Cincinnati, to which I refer. I cannot state the degree of heat obtained in other ways, except by reference to books.

58. What is it which is patented to Mr. Tilghman, in your opinion? Is it the principle of applying heat and water at any particular
142 degree of heat to produce a given result, or is it for a particular process of producing a result? If the latter, what do you call his process, and what the result produced? Or is it for the particular description of machinery to be used as described in his patent? Is any part of the machinery, as described in the specification of Mr. Tilghman, any part of his patent right, as you understand it?

(Objected to as the construction of patent is matter of law.)

The principle patented to Mr. Tilghman, in my opinion, is the production of fat acids from fats by the application of highly-heated water. My opinion is, that the patent is not for the machinery, but as just stated, for the production of fat acids by highly-heated water.

59. You say, in your opinion, about half the product showed you as coming from Mr. Week's factory, is decomposed by the process he uses, and converted into free fat acid by the water introduced, and the other part is formed by the lime. Is it your opinion, that, if there was a sufficient degree of heat in Mr. Werk's tank to effect a separation of a part of the fatty substances into glycerine, and into free fat acid, that such heat would not effect a separation of the whole quantity in the tank? Or is it your impression that it requires a higher degree of heat to separate the whole than a part, supposing the same degree of heat to be infused through the whole mass?

(Objected to, because the first part of the question implies that the witness has stated something which he has not.)

I stated, as my opinion, in a previous answer, that about one-half of the fat was decomposed by lime to form a lime-soap, and the other half was decomposed by the highly-heated water, as in Tilghman's process, to form free fat acids and glycerine. My opinion is, that the same degree of heat, in highly-heated water, which would separate a part of the free fat acids and glycerine would separate the whole.

60. You say Regnault, in his process, passes steam through the fats heated to a temperature equal to 572° Fahrenheit. Do you think

more or less than that degree of heat is necessary to produce free fat acids from fatty substances by using only water with the fatty substances?

Regnault states that the fats can be decomposed at that temperature into free fat acids, with the destruction of glycerine, by the use of highly-heated steam; but the evidence taken at Cincinnati, in the present case, shows that a lower temperature may be employed by the use of highly-heated water.

61. Does not Regnault, in the English edition published in Philadelphia in 1852, p. 187, say, "If fats be heated to a temperature of 570° in an apparatus traversed by a current of steam, under a pressure inferior to that of the atmosphere, the glycerine is converted into
143 several products soluble in water, while the fat acids set free distil without alteration—thus furnishing an example of saponification by heat alone? Please state whether, in your opinion, and, if any, what difference in the results produced by the mode or process suggested in Regnault and in that of Mr. Tilghman, except the destruction of the glycerine in the one case, and not in the other. State also, whether the glycerine, as saved by Mr. Tilghman's process, as you say, would be worth, as a merchantable article, the cost of preparing it for market.

The quotation from Regnault in the question is correct; but the term saponification is not applied, so far as I know, in England, Germany, or the United States, to any other operations, except those on the fats, by alkaline bodies—potash, soda, or lime—also including oxyde of lead. The process of Regnault refers to the distillation of fat acids; the process of Mr. Tilghman refers to the separation of fat acids and glycerine only. The process of Regnault employs heat and steam; the process of Mr. Tilghman employs highly-heated water. If the glycerine should cost more than it is worth, those who use Tilghman's process would not make it. I infer, from the value of glycerine on sale, that it would be worth the preparation by this process. In my opinion, with the exception made in the question, both processes should equally produce fat acids. In Tilghman's process, fat acids mixed through the water; in Regnault's process, acids rising with the steam.

62. Does not Mr. Payne, in his chemistry, in the article which you have referred to, also say that fatty bodies may be decomposed, under the influence of temperature, into several products, and transformed principally into fat acids, which are afterwards subjected to distillation? Is not that the substance of his article, when reduced into English? Does not the distillation of fat acids improve them for manufacturing purposes? Did you, in your experiments in the laboratory, ever produce free fat acid except by distillation?

Mr. Payne, in the article referred to, says that fatty bodies may be decomposed, under the influence of temperature, into several products, and transformed especially into fat acids, which pass over during distillation. He does not say they are afterwards subjected to distillation. As far as I know, the fatty acids are subjected to distillation to improve their quality. I have never obtained them, except by distillation, in my own experiments.

63. You say free fat acids are produced by Mr. Tilghman's process by heat and water alone, or with heat and water, with the use of
144 half a pound of lime to 100 pounds of fatty substance. Is there anything mentioned in Mr. Tilghman's specification or patent about the use of any portion of lime? From whom did you understand Mr. Tilghman uses a half to one pound of lime to 100 pounds of fatty substance?

Mr. Tilghman's specification makes no mention of lime by name; but for decomposition of those fats which are a little impure, proposes the use of a small quantity of alkaline or basic matter; and the alkaline or basic matter known to manufacturers are potash, soda, and lime. I learn from the deposition taken at Cincinnati, in the present case, that from a half to one pound of lime to 100 pounds of fat is often used.

64. What degree of temperature is required to decompose water? Do you understand that in Mr. Tilghman's process the water is decomposed?

To decompose water by heat I know of no temperature. To decompose water in the presence of carbon alone, about a white heat or a bright red heat is required. Where fats are decomposed into fat acids and glycerine, in the presence of water, the elements of water are added to the composition of both the fat acids and glycerine at the temperature of the operation performed, whatever that may be, whether at the temperature of melting lead, or of common temperature of the air. In Mr. Tilghman's process, so much of the elements of water is taken up as is necessary to form free fat acids and glycerine. Little or no other water in Mr. Tilghman's process is decomposed.

65. Why do you think that free fat acids cannot be formed by the English process referred to in the Repertory of Patents, p. 205? Is it because a heat of 310° Fahrenheit would not produce it, or why?

Dunn's process, in the Repertory of Patents referred to, employs a sufficient quantity of real soda, or caustic soda, to completely saponify the quantity of fats which he states to be employed. There can, therefore, be no free fat acids formed by his process. A temperature of 310° Fahrenheit might produce free fat acids without the use of soda, and with the use of water alone, but it could not produce free fat acids under these conditions, namely, the presence of a large percentage of caustic soda. Dunn's process is exclusively for the formation of a soda-soap, and not for the production of fat acids.

76. You say Mr. Tilghman states, in his specification, he sometimes adds a quantity of alkaline or basic matter to the water and fat. Does he not say that he uses those alkaline substances when the fat contains impurities which would injure the iron tubes through which he proposes forcing the liquid matter in process of separation?

In Tilghman's specification he says that he employs the alkaline or basic matter for some fatty bodies, particularly when impure, to neutralize a portion of acetic or other soluble acids, which might tend to injure the iron tubes. He does not state that he employs it for impure fats alone, but for some others, also, which are found to generate a portion of acetic or other soluble acid.

Re-examined by Mr. Harding:

67. You have referred to the testimony of the witnesses taken at Cincinnati, in this case, by the defendant. Do you regard the term "acid lime-soap," as applied by them to the product of defendant's process, to be a correct chemical term and give your reasons?

It is not a correct chemical term, but it should be termed a mechanical mixture of lime-soap and free fat acids, with a little free glycerine. I have never read of an acid lime-soap in any work on chemistry, theoretical or practical, but always of simple lime-soap, which consists of one equivalent of anhydrous stearic acid, and one equivalent of lime. I have used the term stearic acid, although there are other fat acids present, because it is the most important of those acids. The composition of the anhydrous stearic acid to which I have alluded, when ex-

pressed in chemical equivalents, is—carbon 36 + 35 hydrogen + 3 oxygen, which, in lime-soap, is combined with the elements calcium and oxygen, one equivalent of each. By weight these proportions will be 28 pounds of lime, are combined with 275 pounds of anhydrous stearic acid in lime soap, or one pound of lime with $9\frac{82}{100}$ pounds anhydrous stearic acid. Stearine contains $92\frac{7}{10}$ per cent. of anhydrous stearic acid. Stearine is the most solid portion of fatty bodies. Since it has been shown that a half pound of lime, in the presence of highly-heated water will give a product of about 5 pounds of stearate of lime, and about 90 pounds of free fat acids, therefore, if the product of Messrs. Werk's operations be an "acid lime-soap," the product just before referred to, where half a pound of lime is employed, must also be an acid lime-soap; and this acid lime-soap will have the composition of one equivalent of lime with upwards of twenty equivalents of stearic acid, a composition which is wholly unknown to the chemist for any compound whatever, with fat acids, or any other acids. Every chemist living would regard such a compound as a mixture of lime-soap and free fat acids. Since chemists are unacquainted with any other lime-soap of stearic acid than that containing one equivalent of lime and one equivalent of stearic acid, therefore the product of Werk's is a mixture of lime-soap and free fat acids. By treating the alleged product of Werk with alcohol, which dissolves the fat acids and glycerine, but which does not dissolve lime-soap, I found that the dry pro-
156 duct of Werk contained $56\frac{52}{100}$ per cent. of lime-soap. Werk's product treated by another solvent, called benzole, gave a result of $56\frac{42}{100}$ per cent. of lime-soap. The lime-soap obtained by means of these solvents, when subjected to analysis, yielded $5\frac{21}{100}$ of lime. From the known composition of simple lime-soap $5\frac{21}{100}$ parts of lime should combine with $51\frac{16}{100}$ parts of anhydrous stearic acid. By my analysis it was combined with $51\frac{31}{100}$ parts, which proves it to have been a simple lime-soap. The solvents above alluded to, viz, alcohol and benzole, have, therefore, merely dissolved the fat acids and glycerine, and left undissolved the lime-soap. The nature of Werk's product is, therefore, a mixture of lime-soap, with free fat acids and a little glycerine. In a chemical sense, a mixture of lime-soap and free fat acids cannot be called an acid lime-soap.

68. As compared with the process of manufacturing fat acids, commonly employed prior to Tilg'man's invention, by using 14 pounds of lime to the 100 pounds of fat, and about 36 pounds of sulphuric acid, does or does not the process patented by Mr. Tilghman show a reduction in the quantity of lime to be employed to zero, or a small compartive amount?

It does.

69. Does not the said process of Tilghman show a reduction in the quantity of sulphuric acid to be employed, corresponding to the reduction in the amount of lime?

It shows a chemically proportionate reduction.

70. In the said process of Tilghman, is not the reduction in amounts of lime and sulphuric acid respectively, due to the employment of the chemical power of highly-heated water?

Entirely so.

71. Do you find, in any of the processes mentioned or described as being prior in date to that of Mr. Tilghman, any indication of the fact that, by the employment of the chemical power of water in a highly-heated state, the whole or a portion of the lime and sulphuric acids heretofore used in the manufacture of fat acids, could be dispensed with?

I have not found any such indication.

72. As compared with the old process of using 14 pounds of lime and 36 of sulphuric acid to the 100 pounds of fat, does not the process of the defendants show a reduction in the amount of lime used, and in the quantity of sulphuric acid employed?

It does.

73. Is not this reduction of the quantity of lime and sulphuric acid in Werk's process, due to the fact that the chemical power of water, highly heated, is employed?

157 It is entirely due to that fact.

74. Is not the action of the chemical power of highly-heated water in Werk's process and in Tilghman's, identically the same?

It is the same.

75. Is not the employment of this chemical power of highly-heated water, the feature or characteristic of Tilghman's process as patented?

It is the characteristic feature of his patent.

76. Referring to your answer to cross-interrogatory 33, had you reference to the manufacture of glycerine as a distinct substance, or to the treatment of fatty bodies, and to the obtainment of fat acids and glycerine therefrom?

I had allusion to the preparation of glycerine alone; even then glycerine was usually obtained as a secondary product—a lead-soap employed in the pharmacy being the principal product. I designed no allusion to the preparation of fat acids.

77. Have you been familiar with the various processes used in the arts for treating fatty bodies, in which glycerine was obtained as an incidental or secondary product?

I am acquainted with the ordinary process of saponification by the alkalies, potash and soda, but am not aware that glycerine is obtained economically from such operations.

78. Do you mean by your answer to the 60 cross-interrogatory, to convey the idea that Regnault's process and that of Tilg'man, are similar, with the exception of the degree of heat employed in the two cases respectively?

No, sir; they are quite different.

79. In Regnault's process, would the presence of water in a liquid state be possible?

No, sir; it would not be possible.

80. Why?

Because, at a temperature of 570, water cannot remain in a liquid state, except in a vessel sufficiently tight and strong to bear a pressure corresponding to the temperature of 570, and as his process involves distillation, any steam or water thrown into the vessel, must be immediately carried over in the state of steam.

81. Would not tarry matter be formed, as a residue, in the still in Regnault's process?

158 It would.

82. Would not that involve a destruction or loss of a portion of the fatty matter operated upon, and which would, in the Tilghman process, or the Werk process, be converted into fat acid?

It would involve such a destruction or loss of a portion of the fat acids which would be saved by the process of Tilghman or Werk.

83. Is not the presence of water in a liquid state, essential in both the process of Tilghman and of Werk?

It is essential.

84. Has the process of Tilghman or that of Werk, any resemblance whatever to a process of distillation?

It has not the slightest resemblance.

85. From your knowledge of chemistry, who would you say was the discoverer of the chemical power of water in a liquid state, at a high temperature, on fats, to produce fat acids and glycerine?

Mr. Richard A. Tilghman.

86. Do you know of any other person who has claimed the merit of this discovery?

I know of no other.

87. Is not this discovery regarded as a new and important fact in chemistry?

It is so regarded.

(Objected to as not calling for his opinion, but what others say about it, and because it is not confined to witnesses opinion.)

Recross-examined:

88. Please state whether the particular degree of heat required in Tilghman's process, to separate the free fat acid from the glycerine, is mentioned. Could you ascertain the precise degree of heat required, by reading that patent and specification? If yea, state it.

A specific degree of heat is mentioned as giving good results, but a lower and even a higher temperature is also mentioned as capable of being used; and it is advised by the patentee to begin at a low heat and gradually increase it, until it yields the product most suitable to the intended application of the fatty body. The specific degree alluded to is the temperature of melting lead. The degree of heat for each particular kind of fat is not mentioned in the patent.

159 89. Could any manufacturer of stearic-acid candles, from the description in that patent of the heat required to produce a separation of the free fat acids from the glycerine, determine, without further experiment, the temperature required to produce the separation.

Yes, sir; he could do it without further experiment.

90. Can you now give me from that patent, the exact degree of heat or temperature required by Mr. Tilghman's process to produce a separation of the free fat acids and glycerine, usually used by manufacturers of stearic candles.

Anywhere between 450 and 650 would be the temperature mentioned in the patent, although the patent allows a lower temperature to be used.

91. Do I understand you, then, to say that the patent is founded upon the application of highly-heated water, so as to produce separation of fat acids and glycerine, and not upon any particular degree of heat required to produce such separation.

That is the only claim of the patent.

92. Please name the person or persons who have testified in this case as to the degree of heat required by Mr. Tilghman's patent, to produce a separation of fat acids from glycerine, and at what degree of heat does such witness say the separation will be effected.

Mr. Graselli states that it would require 600° of heat with water alone. Mr. Wayne states that between 600 and 700° are used. He says again, "that distillation of that kind can be produced by a temperature from 550° to 650°." By Mr. M. Ropes, jr., that the decomposition by water was effected by a temperature of about 350°, or as it is expressed in his testimony, by a pressure of 150 to 155 pounds. C. H. Grant mentions having decomposed fat at the temperature expressed by a pressure of

150 pounds pressure to the square inch. Ropes, sen., mentions having executed the decomposition at 150 pounds pressure, which corresponds to about 350° Fa'renheit.

93. How long since you first learned of Mr. Tilghman being the first discoverer of highly-heated water being sufficient to produce the separation of free fat acids and glycerine? Was it before or after the publications referred to by you in this deposition, which speak of separating those substances—Regnault, Payne, Roret, and Dunn?

(Objected to; all those books do not speak of the separation of fat acids and glycerine.)

160 I first learned of Mr. Tilghman being the first discoverer, some five or seven years since. The publications were all before.

94. State whether you know of any manufactory having successfully adopted Mr. Tilghman's process of separating free fat acids and glycerine by heated water alone. If yea, where are they, and how long have they been established?

Mr. C. H. Grant has been at work at it now for some 10 or 12 months. Mr. N. Ropes, at the time of giving his testimony in this case at Cincinnati, had been at work at it about two months. Both have been successful in that operation, according to their own statement. These are all. Mr. N. Ropes is in Cincinnati, and Mr. C. H. Grant is in Philadelphia.

95. Do you know anything personally about the working at Mr. Grant's or Mr. Ropes' establishment, or is your knowledge confined to the reading of the depositions of these gentlemen?

My knowledge is derived from the depositions of Mr. Ropes and Mr. Grant, and from personal intercourse with Mr. Grant within the last month.

96. Do you not know that the plaintiff was at the expense of putting up a boiler or tank used at M. Ropes' factory; did not Mr. B. C. Tilghman attend to putting it up under an agreement with Mr. Ropes, that if on a full trial he should be satisfied he could produce a merchantable article, free fat acid, so as to use for candle stock, that then he would buy the boiler or tank, and would purchase the right to use the patent? Do you know that Mr. Ropes has ever been satisfied with the operation so as to make the purchase?

I know nothing more about it than is stated in the deposition of Ropes taken at Cincinnati.

Is it not stated in the chemical works of Regnault & Payne that, prior to those publications, it had been discovered that free fat acids could be produced by heat alone.

It is stated that it could be produced by heat alone; the acids distilling over, the meanwhile, but it is no where stated by them that the decomposition can be effected by highly-heated water.

98. Can this separation of fat acids and glycerine be effected by heat alone, without water. If so, how?

It can be effected, but accompanied by a partial destruction of fat acids, and a total, or almost total, destruction of glycerine.

161 99. Do you understand the articles referred to in the books last referred to as proposing a separation of those substances, without the application of water?

They nowhere speak of their separation by the use of water. I understand them as proposing the separation without the application of water. Steam is not water in the sense I use the term.

100. Do you understand from either of those works that steam is used to aid in the separation of free fat acids and glycerine?

I understand from those books that steam has been used to distill fat acids, and by its use the glycerine is more of less destroyed.

101. You say you do not consider steam to be water. Do you not consider that water is used to create steam, and the steam is again reduced by condensation in Mr. Tilghman's apparatus?

In every steam-tight vessel containing water there is, when heated, always a portion of steam above that water, and the quantity of this steam will be proportioned to the space above the water and the heat applied. When, therefore, the vessel is filled with water, there can be no steam formed until a vent is open, through which the liquid water will escape in the form of steam, provided the heat alluded to be above 212°. In Mr. Tilghman's specification it is expressly required "that the vessel shall be closed so that the requisite amount of pressure may be applied, to prevent the conversion of the water into steam," and in the description of the working of the apparatus given in the patent the whole vessel and tubes are completely filled with water and fat, so that there can be no space for steam to form, and consequently no steam formed.

102. Why is there provision made for a safety-valve?

In order that the water and fats may not be heated beyond the temperature which the pressure on the safety-valve will allow.

103. Please state whether, at the date of Mr. Tilghman's patent, and how long prior thereto, the manufacturers of stearic acid had not almost universally used lime in connection with heated water, to produce a separation of fat acids from the glycerine, sometimes using the fat and water and lime in open tubs, and sometimes in a tub covered with boards, the latter being weighted down more or less by weights placed on the top.

I have never heard of their producing fat acids by such processes, prior to Tilghman's patent, but only lime-soap.

104. What process did the lime-soap then undergo in order to produce free fat acid?

It was decomposed by a quantity of sulphuric acid, rather more than equivalent to the quantity of lime it contained.

162 105. Do you not know that, prior to the patent to Mr. Tilghman, manufacturers were, by the use of steam and heat applied to tubs and tanks, producing free acids from fatty substances with from 9 to 10 pounds of lime; and, as they from time to time introduced more heat into the tub or tank, they used less lime to produce the same result?

I do not think they did produce free fatty acids with that proportion of lime, say 9 or 10 per cent. of the fat. They used about 14 pounds to the 100; and in using a higher degree of heat, and mixing better, they might reduce it to 10 to 12 per cent.

Re-examined:

106. Please furnish English translations of the passages in the French works referred to by you.

I will do so, and cause them to be annexed.

JA'S C. BOOTH.

UNITED STATES,

Eastern District of Pennsylvania, set:

Be it remembered that, on the twenty-sixth day of July, A. D, 1860, personally appeared at my office, United States court, No. 104 South Fifth street, in the city of Philadelphia, before me, Charles F. Heazlitt,

a commissioner appointed by the circuit court of the United States in and for the eastern district of Pennsylvania, in the third circuit, under the laws of the United States, to take affidavits and acknowledgments of bail, &c., ROBERT E. ROGERS, to testify, and the truth to say, on the part and behalf of the plaintiff, in a certain suit or matter of controversy now depending and undetermined in the circuit court of the United States in and for the southern district of Ohio, wherein Richard A. Tilghman is the plaintiff, and Michael Werk is the defendant.

And the said witness being of lawful age, and having been by me first cautioned and sworn to testify the truth, the whole truth, and nothing but the truth in the matter of controversy aforesaid, did thereupon depose, testify, and say as follows, viz:

1. What is your name, age, residence, and occupation, and how long have you followed the same?

163 Robert E. Rogers; aged 43 years; and am by occupation professor of chemistry in the medical department of the University of Pennsylvania. I have occupied that chair seven or eight years. I have followed the profession of a chemist twenty years and upwards.

Adjourned until to-morrow, at 9 a. m.

JULY 27, 1860.

Present, Mr. Harding and Mr. Fox.

The examination proceeds:

2. If you have filled any other posts in public institutions, please name them?

I occupied the chair of chemistry in the University of Virginia between nine and ten years; was chemist to the geological surveys of Pennsylvania and New Jersey for several years.

3. Are you acquainted with the various processes used in the arts for the manufacture of fat acids and glycerine?

I am.

4. Have you read, and do you understand, the patent granted to the plaintiff in this case, dated October 4, 1854?

I have read it, and do understand it.

5. Have you read, and do you understand, the answer of the defendant in this suit, as contained in the certified copy now shown you?

I have read the answer, and do understand it, as contained in the copy now shown me.

6. Have you read, and do you understand, the patent of the defendant, dated October 5, 1858, and referred to in that answer?

I have read, and do understand, the patent of the defendant, dated October 5, 1858.

7. State whether the process of defendant, as set forth in his answer, is substantially the same, or different in principle and operation from that described and claimed in said plaintiff's patent?

I regard the process of defendant as the same in principle and operation as that of the plaintiff, as set forth in the plaintiff's patent.

8. Did you analyse an alleged specimen of the product of defendant's process? If aye, from whom, and when did you receive it? and give your analysis of the same fully and in detail.

164 I did analyse an alleged specimen of the product of the defendant's process. I received the same from Professor James C. Booth on the 20th of June, 1860, of which the following is the result:

Fat acids	29.27
Glycerine	2.41

Lime-soap	41.10
Water	25.97

The lime-soap above referred to yielded of lime 9.4 per cent.

9. Have you read, and do you understand, the passage in A. Payen's Chemistry, page 766, referred to in defendant's answer?

I have read the passage alluded to, and do understand it.

10. State whether the process described in Payen's Chemistry is substantially the same as that described in plaintiff's patent, and point out in detail wherein said processes resemble or differ from each other in principle and operation.

The processes described in Payne, page 766, are not substantially the same as that of the plaintiff, and have, in reality, in point of principle no feature of resemblance to it. The processes of Dupuy, Bussy, and Lecanu refer to the decomposition of fatty bodies, under the influence of heat simply, in which fat acids are distilled over. Thomas & Laurent are spoken of as using superheated vapor of water or steam; and Dubrunfaut as manufacturing fat acids by decomposing fats by means of a current of steam at a high temperature; and Frémy as effecting saponification by means of sulphuric acid. No one of these processes produces simultaneously free fat acids and glycerine. No one of these processes alludes to the presence or instrumentality of liquid water. No one of these processes includes the feature in Tilghman's process of the power of liquid water, at high temperature and pressure, of resolving fatty bodies into free fat acids and glycerine, ready both to be withdrawn from the vessel when it is opened, the fat acids as such, and the glycerine held dis'olved in the water. All of the processes described in Payen, excepting that of Frémy, directly involved the distillation of the fat acids, and in this differ from Tilghman's. The saponification by sulphuric acid of Frémy differs from Tilghman's in every point.

11. How do the processes mentioned in Payne agree or differ from Tilghman's, so far as concerns the use of pressure?

They differ from Tilghman most widely, since they involve no confinement in close vessels, and, therefore, no pressure beyond that of the weight of the atmosphere, while Tilghman's process is conducted in a close vessel, in which pressure upon the confined materials is obtained.

165 12. Please state why pressure is essential in Tilghman's process?

Pressure is essential in Tilghman's process as a means of securing a sufficient temperature of the water, in contact with the fatty substances, for the conversion of the fatty substances with free fat acids and glycerine. A higher temperature than 212° cannot be maintained in water, unless the water be subjected to pressure.

13. How do the processes of Payen agree or differ from that of Tilghman's, so far as relates to the use of close vessels?

The processes in Payen involving distillation require open vessels. The process of Tilghman in this respect is diametrically opposite, demanding close vessels, thereby furnishing pressure and hence securing the high temperature needed in the decomposition of the fatty bodies into fat acids and glycerine.

14. Have you read, and do you understand, the extract from Regnault's Chemistry contained in Prof. Booth's answer to the fourteenth interrogatory of his examination in this case; and do you confirm the accuracy of the translation of the said passage there given?

I have read, and do understand and confirm, the translation in Prof. Booth's answer above referred to.

15. State whether the process set forth in said work is substantially the same as that described in plaintiff's patent; and point out in detail wherein they resemble or differ from each other in principle or operation?

The processes of Regnault and Tilghman in no way resemble each other. Regnault's process heats the fatty bodies to high temperature, and transmits low steam through them in an open vessel. Tilghman's process heats together the fatty bodies and water to a high temperature in a close vessel. Regnault's process destroys the glycerine, and distills over the free fat acids. Tilghman's process neither destroys the glycerine nor distills over the free acids, but resolves the fatty substances, by the contact of the heated water, into free fat acid, on the one hand, and free glycerine, dissolved in water, on the other; both ready to be withdrawn from the vessel at the pleasure of the operator.

16. Have you seen in any published work a description of processes for the manufacture of lime-soap and common soap in close vessels under pressure? If aye, name the works and describe the processes.

I have seen and read in the Manuel of Roret, or Encyclopediæ Roret, published in Paris in 1849, a description of a process for the manufacture of soaps by the employment of close vessels and of pressure. In that work the saponification is effected in a cylindrical boiler hermetrically sealed, provided with a stuffing-box, through which a
166 stirrer passes. Into the cylindrical vessel or boiler the fatty substances and milk of lime are introduced and heat applied, with a thermometer standing at about 276° Fahrenheit—equivalent to 30 lbs., or two atmospheres' pressure upon the materials within the vessel. The saponification being effected, the contents of the vessel are permitted to cool to 212°, and thus reach the normal pressure of the atmosphere, and are withdrawn. I have read in Repertory of Patent Inventions, new series, vol. 11th, page 205, the specification of the patent granted to Arthur Dunn, August 24, 1838, the description of the improvement in the manufacture of soap; in which the saponification is effected in close, or covered or steam-tight vessels, so that the saponifying process may be performed under steam pressure and at temperature exceeding the ordinary boiling-point of water. In said description the temperature proposed to be used is about 310° of Fahrenheit, equivalent to about 60 lbs. pressure. The vol. of the Repertory referred to was published in London in 1839.

17. Please state how the process contained in Roret which you have referred to, resembles or differs from that of the plaintiff's?

The process described in Roret involves the use of lime in sufficient quantity to make a soap with the fat acids, and takes no account nor admits of the instrumentality of the water as a special decomposing agent in the process. Tilghman's process involves the use of and depends upon the peculiar chemical agency of water under the high temperature, to which it and the fats with which it is associated are subjected.

18. What is the nature of the chemical product formed in the process contained in Roret?

It is a compound consisting of the alkaline base equivalent to neutralize the fat acids of the fatty substances, and in accordance with the laws of chemical combination, may be termed a neutral salt, on which acid and base have mutually satisfied each other's affinities. In common language this compound is a soap. Lime being used it is a lime-soap.

19. What is the nature of the chemical product formed in Tilghman's process?

In Tilghman's process there is no soap formed, but the fatty substance, under the influence of high temperature in the presence of and through the instrumentality of the water used, is resolved and
167 transformed into free fat acids, on the one hand, and free glycerine on the other.

20. In the process in Roret is there any free fat acid produced?

There is none.

21. Is there anything in the description of the said process that would lead any one to suppose that free fat acid was produced or intended to be produced?

On the contrary, the description of the process in Roret precludes the possibility of any free fat acids being developed, recognizing them as being neutralized by the lime which is employed.

22. What would be the quantity of lime per hundred pounds of fat requisite in practice to carry out the process described in Roret?

To secure complete saponification of the fat from 12 to 15 lbs. of lime per hundred of the fat should be employed.

23. Please state how the process in Dunn's patent, referred to from the Repertory, resembles or differs from Tilghman's process?

In Dunn's process, in the manufacture of soaps generally, he recognizes the necessity of a quantity of the alkaline base used fully equivalent to neutralize the fat acids contained in the fatty substances; and employs a close steam-tight vessel for the purpose of effecting a combination of the fat acids with the base more speedily that would be accomplished by boiling them together in open vessels. In Tilghman's process no alkali is employed nor need be employed, since the water alone under high temperature in contact with the fatty bodies is competent to transform them into free isolated fat acids and glycerine.

24. In Dunn's process is there any free fat acid produced?

In Dunn's process there is no free fat acid produced.

25. In the description of Dunn's process is there anything that would lead any one to suppose that free fat acid was produced or intended to be produced?

There is nothing.

26. From the descriptions given in Roret and in Dunn do you understand that the use of close vessels and pressure was intended solely to produce neutral soaps more speedily than would be effected in open vessel and without pressure?

I do so understand it, as intended solely to produce neutral soaps more speedily than would be effected in open vessels and without pressure.

168 27. From the knowledge obtained by you of the defendant's process from the answer filed, and his patent referred to therein, and your analysis of the alleged product of the defendant's process, please state minutely and in detail wherein the defendant's process embodies the features or principle of operation of plaintiff's patent?

The defendant, though professing to use superheated steam as the means of facilitating saponification, in reality, by the very nature of the means through which he attempts to accomplish the object, employs or avails himself of the cardinal feature of Tilghman's process. When he conveys superheated steam into a tank containing water mingled with fatty substances, he simply employs that superheated steam as a means of giving high temperature to the water and fats of the tank. The boiler generating the steam being in communication with the tank containing the water and fat, an equilibrium of pressure and consequent temperature between the two must, by necessity, exist;

if the steam in the boiler then be under high pressure, the liquid in the communicating tank must be under the same, and the procuring and maintaining of high temperature is the peculiar and distinctive feature of Tilghman's process, when water and fatty substances are mingled in a close vessel. This high temperature to which the defendant, by his means, subjects the mixture of water and fats, accomplishes directly, through the chemical agency of the water, a transformation of a large portion of the fatty substances into free fat acids and glycerine; and, therefore, so far as there are developed by defendant's process any free fat acids and glycerine, defendant's process is identical with plaintiff's. The production of a smaller or larger amount of lime-soap through the use of lime by defendant, does not at all exclude that principle of Tilghman's process which is operating to so large an extent in the defendant's process.

28. You have stated that you have found by analysis a certain quantity of free fat acid in defendant's product. Please state whether or not the chemical agent in producing the free fat acid in defendant's process, as described, is water at a high temperature under pressure?

The chemical agent which has produced the free fat acid in the product of defendant's process is undoubtedly water at a high temperature under pressure.

29. So far as the lime-soap in the defendant's product is concerned, state whether or not this lime-soap is produced by the process described in Roret?

The lime-soap contained in defendant's product is produced by the process described in Roret, and depends upon the same chemical re-action of simple saponification of a fat by lime under pressure.

169 30. State whether or not two distinct chemical processes are concerned in the formation of defendant's product, one for the production of the free fat acid portion thereof, and the other for the production of the neutral lime-soap portion thereof, and identify those processes?

There are two distinct and independent chemical processes concerned in defendant's process; one consists of the production of free fat acids and glycerine, and the other in the production of a neutral lime-soap. The first named, "the production of the free fat acid and glycerine is Tilghman's process." The second, the production of the lime-soap is the process described in Roret.

31. So far as relates to the chemical action involved in the formation of the free fat acids in the defendant's process, does it make any difference whether defendant's tank is heated by the introduction of superheated steam, or by any other heating agent, such as common steam, or a fire placed below said tank?

It matters not how the heat is applied to the contents of the tank in defendant's process, whether by superheated steam, ordinary steam, or a common fire applied, since in either case the free fat acids are developed through the same chemical action of water at a high temperature under pressure, which is Tilghman's process.

32. What is superheated steam, and what becomes of superheated steam on its introduction into defendant's tank?

Superheated steam is the dry vapor of water heated by any means above the temperature of 212°, designed to possess a higher temperature and pressure than ordinary steam. When transmitted into defendant's tank, it at first condenses and loses its pressure, giving its heat to the contents of the tank; as the contents rise in temperature the superheated steam loses less and less of its temperature and pressure;

an equilibrium of temperature and pressure between the tank and tubes containing the superheated steam is now established; the pressure on the contents of the tank being caused by and dependent upon the pressure of the superheated steam. The superheated steam is thus but a means of establishing a high pressure and temperature in the tank, the fact of superheating the steam in tubes placed between the boiler and the tank does not materially increase the pressure upon the contents of the tank, the pressure in the tank being dependant upon, and the same as the pressure on the boiler.

33. Is it or is it not a notorious fact that water cannot be heated in a close vessel above 212° Fahrenheit, without the existence of a
170 pressure on said close vessel corresponding to the temperature of the water?

It is a notorious fact that water cannot be heated in a close vessel above 212° Fahrenheit, without the existence of a pressure on said vessel corresponding to the temperature of the contained water.

34. Please state whether or not the proof of the existence of free fat acids in defendant's product can be made by any simple and easy test; and, if so, explain in what manner?

The existence of free fat acid in defendant's product can be readily proved by the following simple tests: The free fat acids may be dissolved out by means of strong alcohol, the alcohol evaporated away, and the fat acids left; a portion of the substance brought in contact with litmus blue, either in solution or as test paper, reacts strongly in producing a red color, the characteristic of acid; the same residue from the alcoholic solution brought in contact with dry carbonate of soda, reacts by evolving the carbonic acid, and, combining with the soda, producing a soap, another characteristic of a fat acid; or, a portion of the same warmed in contact with iron filings, evolves hydrogen gas by the decomposition of water, giving a further evidence of its acid character.

35. What other substances beside alcohol could be used to separate the free fat acids of the defendant's product?

Benzole, ether, and chloroform.

36. Would the application of alcohol and the other substances you have named extract any free fat acid from the product of the process described in Roret, or that described in Dunn's patent, or that of the common saponification in open vessels with 12 or 14 per cent. of lime?

These substances would not extract any free fat acids from the products of any of the processes above referred to.

37. Have you read the testimony taken on the part of the defendant in this case in Cincinnati? If aye, state whether the use by the witnesses Wayne and Grasselli, of the term "acid lime-soap," to describe defendant's product is a proper chemical description of said product, and give your reasons.

I have read the testimony taken on part of the defendant in this case in Cincinnati, and would state that the term "acid lime-soap," as applied to describe defendant's product is not a proper chemical description of said product. In accordance with the well-established laws of chemical combination every base is capable of combining with an acid only in definite and fixed proportions, and when such base is
171 combined with its acid the acid can only be liberated in the free state by presenting to the base a stronger acid; the fact that alcohol, ether, chlorform, or benzole can respectively remove from the product of defendant a large percentage of free fat acids conclusively demonstrates that those acids so removed had not existed in combination with any base, but were altogether in an uncombined or free con-

dition; further evidence of the incorrectness of the term "acid lime-soap" is the fact that, assuming the possibility of lime combining with more than one proportion of the fat acids, the quantity of such acids found in the specimen analysed in no way corresponds with the combining quantity of lime, but greatly exceeds it. Viewed by any interpretation which sound chemical principles would admit of, there is no means of accounting for the free fat acids which are separated by alcohol æther, chlorform, and benzole, except by regarding them in a free and uncombined condition. The assumption by Mr. Wayne, in his testimony, that because a strong mineral acid added to a soap removes the fat acid from the base, and permits water to combine with the fat acid therefore this hydrated acid cannot be regarded as a free acid, is unsound in principle and practice. Were such a view or interpretation to be accepted we should expunge from the list of acids the important substances known in commerce as sulphuric acid, nitric acid, and phosphoric acid. It is a familiar fact to chemists that the very existence in a separate isolated or free form of many acids depends upon their associating themselves with water in the act of being separated from bases. The circumstance of an acid, therefore, having water to replace a mineral base, does not prevent them being universally regarded as free acids.

38. As compared with the processes of manufacturing fat acids commonly employed prior to Tilghman's patent, by using about 14 lbs. of lime and 36 lbs. of sulphuric acid to the 100 pounds of fat, does or does not the process patented by Mr. Tilghman show a reduction in the quantity of lime to be employed to zero, or a small comparative amount?

It does.

39. Does or does not the said process of Tilghman show a reduction in the quantity of sulphuric acid to be employed, corresponding to the reduction in the quantity of lime?

It does.

40. In the said process of Tilghman, is not this reduction in the amount of lime and sulphuric acid due to the employment of the chemical power of highly-heated water?

It is.

41. Do you find in any of the processes mentioned or described as being prior in date to that of Mr. Tilghman's, any indication of the
172 fact that, by the employment of the chemical power of highly-heated water, the whole, or a portion of the lime and sulphuric acid heretofore used in the manufacture of fat acid could be dispensed with?

No; I do not.

42. As compared with the old process of using 14 pounds of lime and 36 pounds of sulphuric acid to the 100 pounds of fat, does or does not the process of the defendant show a reduction in the quantity of the lime and sulphuric acid employed?

It does.

43. Is or is not this reduction of the quantity of the lime and sulphuric acid in defendant's process due to the fact that the chemical power of highly-heated water is employed?

The reduction is due to the chemical power of highly-heated water employed in defendant's process.

44. Is or is not the action of the chemical power of highly-heated water in defendant's process and Tilghman's process identically the same?

It is identically the same.

45. Is or is not, the employment of this chemical power of highly-

heated water the characteristic feature of Tilghman's process, as patented?

It is.

(Objected to as illegal.)

46. From your knowledge of chemistry, who should you say was the discoverer of the chemical power of water in a liquid state at a high temperature on fats, to produce fat acids and glycerine?

From my knowledge of chemistry, and from reading, my conviction is that Mr. Richard A. Tilghman is the discoverer of the chemical power of water in a liquid state at a high temperature on fats, to produce fat acids and glycerine.

47. Do you know of any other person who has claimed the merit of this discovery?

No; I do not.

48. Is or is not this discovery regarded as a new and important fact in chemistry?

It is.

173 Cross-examined by Mr. Fox:

49. Please state the usual process by which stearic acid, for the manufacture of candles, is formed from fatty substances. State the practical manner in which the glycerine and fat acids are separated other than by the process of Mr. Tilghman.

The fatty substances are boiled with the milk of lime—the materials blended as intimately as possible during the process, for a period sufficiently long to effect saponification. The lime-soap thus produced is treated with a sufficient quantity of sulphuric acid to decompose it, and liberate the fat acid from the lime. In the act of combining the fat acid and the lime during the saponification of the fat, the glycerine is liberated and held dissolved in the water. After the saponification has been effected, and the materials withdrawn from the saponifying tank, and the lime-soap separated from the watery solution of the glycerine, the addition of sulphuric acid is made. These details, as well as others which I will give in answer to the question, I desire to state, are based not upon any practical knowledge of candle-making, but upon what I recollect of the subject, as contained in print, and in the answer of defendant.

Payen (the work heretofore referred to) prescribes 14 per cent. of lime for the saponification, and 26.8 per cent. of sulphuric acid for decomposing the lime-soap. And defendant prescribes 14 pounds of lime for the saponification, and 36 pounds of sulphuric acid for decomposing the lime-soap. In this way the free fat acids are isolated.

50. Do you know, from practice or experiment, that the use of steam at a temperature of, say 350° F., introduced into a steam-tight tank or boiler, in which the fatty substances are placed for separation, will produce a perfect separation of the free fat acids from the glycerine without the use of lime or any other base?

I have had no practical experience, and have made no experiment with steam at a temperature of 350°, or any other temperature in a tight tank or boiler upon fatty substances.

51. Supposing Mr. Werk to use a tank, steam-tight, into which he introduces, with each 100 pounds of fatty substances, from 6 to 7 pounds of lime, with about 130 pounds water, heated by the introduction of superheated steam, heated to a temperature of from 340° to 350° of Fahrenheit, what is the substance produced from the operation?

There must, by necessity, be formed through two distinct chemical processes, a lime-soap and free fatty acids and free glycerine. The lime-

soap (the result of the ordinary saponifying process, as described by Roret) and the free fat acid and glycerine, the result of the chemical power of water under the influence of high temperature and pressure, as described in Tilghman's process.

174 52. Are the acids and glycerine free, so as to form what manufacturers call free fat acids and free glycerine, or does it not require the application of sulphuric acid in order to the production of free fat acids from the products above referred to.

The fat acids are in part combined with lime, that much due to the ordinary saponification process, and in quantity equivalent to the quantity of lime; and in part are in a free state, they being due to agency of the water under high pressure and temperature. It only requires so much sulphuric acid as will decompose the lime-soap, but requires no sulphuric acid for that portion of the free acids which have already been developed through the agency of the water under high pressure and temperature. If the manufacturers were content to dispense with so much fat acid as is in the lime-soap, he would still have a large product of free fat acid altogether independent of the use of sulphuric acid. With reference to the glycerine, the whole of it is in a free condition, since the lime, to the extent of its equivalent quantity, by combining with a portion of fat acids, liberates some glycerine, and the chemical power of water, under high pressure and temperature, on the other hand developes the remainder.

53. Is the product above referred to, as produced by Werk, as a whole, a marketable article of free fat acids?

No. It is a mixture of a lime-soap, from which a marketable free fat acid may be produced by the treatment with sulphuric acid, and of (in large quantities) a marketable free fact acid, needing no treatment by sulphuric acid.

54. Is the free fat acid, you say is contained in the product, so separated from the balance that it can be used as a free fat acid, without further reduction or separation?

The free fat acid is, by the very meaning of the term, altogether uncombined with and unembarrassed by any base, and, therefore, any treatment it may be subjected to is not for the purpose of rendering it any more free than it already is, but for improving its color, or modifying its texture. Chemically speaking, it is an isolated acid.

55. Is this free fat acid, if combined with anything which gives it a color, suited in that state for the market as a free fat acid? What is it that remains in the product to give it the color you refer to?

The free fat acid, though having color, cannot be said to be combined with any coloring matter, but only mingled, since it can only combine with some base, and being a free fat acid the very term implies the

175 total absence of any base; and, therefore, so far as the free fat acid itself is concerned, it could fulfil all the wants of the market while it is the coloring matter merely blended with it, which blemishes it. The coloring matter mingled with the free fat acid is organic—the result of the partial decomposition of some of the constituents of the fatty substances used, and is not a mineral base, such as lime, which could combine with sulphuric acid.

56. State whether the glycerine and fat acids can be separated by heat and water alone, economically. If aye, what temperature of heated water is required to produce the separation?

Practically or experimentally I have no personal knowledge of the cost of the separation of the glycerine and fat acids by heat and water alone; but, from a careful reflection upon the methods already in use, in

which it is proposed to be accomplished by water at a high temperature, I am convinced that the latter may be economically conducted. All my knowledge of the effect of water alone, at a high temperature, is derived from a perusal of Mr. Tilghman's specifications, and of the testimony of the witnesses in this case. As the effect of highly-heated water was in itself a discovery in chemistry, experiment alone could determine the range or limits of temperature between which this action takes place; and not having myself performed such test experiments, my knowledge is thus derived from the sources above-named.

57. State the temperature of heated water required to separate the fat acids from the glycerine, where lime, in the ordinary quantity of 14 pounds to one hundred of fat, is used in the steam-tight tank with the water and fatty substance.

The temperature ranges from the ordinary boiling (212°) point, up to any heat short of that at which a destruction of the organic matter takes place. And no specific temperature can be mentioned as necessary to accomplish the separation.

58. How can the water, in a highly-heated state, act chemically upon the fatty substance, and seperate the same. Is it by a decomposition of the water? If not, in what way does it act on the fatty matter?

Chemists are agreed in the conviction, that when fatty substances are resolved into fat acids and glycerine, that the water is not decomposed, but that the anhydrous fat acid and an organic base had existed in combination, constituting the fatty bodies, and when the acid and base are separated, each takes to itself a portion of water, the one becomes the ordinary so-called fat acid, and the other glycerine.

176 59. In the process described in the Encyclopedia of Roret, page 114, in which saponification is produced as therein described, would the degree of heat then used, say 276°, produce a decomposition of the fatty substances by water alone, independent of the milk of lime said to be used?

Were no milk of lime used in the process above alluded to, and water alone, at the temperature of 276°, a transformation into free fat acids and glycerine would take place; but, since a full equivalent of lime was used in that process, the saponification was accomplished through its instrumentality, being expedited by the high temperature employed.

60. Would the heat described in Dunn's patent, 310° Fahrenheit, be sufficient to produce decomposition of the fatty bodies into free fat acid and glycerine, without the introduction of any chemical substance other than the water and fat?

Such heat would be sufficient.

61. If water heated to 310° Fahrenheit, united with a proper quantity of fatty substances, be placed in a steam-tight tank or boiler, would all the fatty substances contained in the boiler or tank, be decomposed into free fat acids and glycerine, supposing the whole mass to be equally heated to the same degree?

It would. The only difference between the action of that temperature and a higher one, would be the time occupied in the transformation. The higher the temperature, the quicker the process.

62. In the process described in Roret, (in Milly & Motard's patent,) and in the Dunn patent, would the presence of the lime or other base used to decompose the fat, prevent the action of highly-heated water from decomposing the fatty bodies in the boiler or tank described in this patent?

Inasmuch as the quantity of lime in the one (Milly & Motard) and the soda in the other (the Dunn patent) are in full proportion to combine

with the whole of the fat acids in the fatty substances, and inasmuch as they do so combine with those fat acids, their presence does prevent the decomposition of the fatty substances by the highly-heated water, because there are no fatty substances left to be decomposed, the lime in the one case, and the soda in the other, having already accomplished the result.

63. How can you tell, as a matter of science, whether the heated water, or the chemical substance used as a base, would first act upon and decompose the fatty substances?

177 Firstly, because a cold alkaline solution will saponify a fat, showing the superior affinity of alkalies for fatty acids; cold water is not known to produce such an effect. Secondly, if the lime did not decompose the fatty substance, and take to itself the fat acid in preference to the water resolving the fatty body into free fat acid and glycerine, we should find the water containing the free fat acid blended throughout it, and the free fat acid not combined with the lime; while, in fact, all of the fat acid is found combined with the lime, and none of it in a free state mingled with the water.

64. Do you understand that, in the process of Mr. Tilghman, the glycerine is perfectly free and separated from the water, so as to be gathered by itself, or is it mixed up with the water?

I understand that the glycerine is entirely separated from the fat acids of the fatty body, and that since the fat acids do not dissolve in water, they either float on its surface or are mechanically blended with or suspended in it, and that the glycerine being soluble by, is dissolved in *in* the water, and can be collected by removing the water by evaporation.

65. Can these fatty bodies be decomposed by highly-heated water by way of distillation. If so, what degree of heat is required to produce the separation?

There is no such thing, properly speaking, as distillation by highly-heated water. Water itself, as water, does not pass over in the distilling process, but it is the vapor of water or steam which passes over, and is afterwards condensed into liquid water. I know of no such process, by which fatty bodies can be decomposed by highly-heated water, in the way of distillation.

R. E. ROGERS.

Adjourned till Monday, July 30, 1860.

MONDAY, *July* 30,

Present: Mr. Harding, Mr. Fox.

UNITED STATES,

Eastern District of Pennsylvania, set:

Be it remembered that, on the thirtieth day of July, A. D. 1860, personally appeared at my office, U. S. courts, No. 104 South Fifth street, in the city of Philadelphia, before me, Charles F. Heazlitt, a com-

178 missioner appointed by the circuit court of the United States in and for the eastern district of Pennsylvania, in the third circuit, under the laws of the United States, to take affidavits and acknowledgments of bail, &c., FREDERICK A. GENTH, to testify, and the truth to say, on the part and behalf of the plaintiff in a certain suit or matter of controversy now depending and undetermined in the circuit court of the United States in and for the southern district of Ohio, wherein Richard A. Tilghman is the plaintiff, and Michael Werk is the defendant. And the said witness being of lawful age, and having been by me first cautioned and sworn to testify to the truth, the whole truth, and nothing

but the truth, in the matter of controversy aforesaid, did thereupon depose, testify, and say as follows, viz:

1. What is your name, residence, age, and occupation, and how long have you followed the same?

My name is Frederic Augustus Genth. I reside in the city of Philadelphia; aged 40 years; am a chemist, and have been engaged in chemistry since 1839.

2. If you have filled any post in public institutions, please name them.

I have been assistant in the chemical laboratory of the University of Marbourg, in the state of Hesse Castle, for three years, and professor in the university for two years.

3. Have you been practising as an analytical chemist in the city of Philadelphia? If so, how long?

I have been practising as an analytical and consulting chemist, in the city of Philadelphia, for nearly eleven (11) years.

4. Are you acquainted with the various processes used in the arts, for the manufacture of fat acid and glycerine?

Yes, sir.

5. Have you read, and do you understand, the patent granted the plaintiff in this case, dated October 4, 1854?

I have read it, and fully understand it.

6. Have you read, and do you understand, the answer of the defendant in this suit, as contained in the certified copy now shown you?

I have read the answer, and do understand it.

7. Have you read, and do you understand the patent of the defendant, dated October 5, 1858, and referred to in that answer?

I have read it, and do understand it.

179 8. State whether the process of defendant, as set forth in this answer, is substantially the same or different in principle and operation for that described and claimed in said plaintiff's patent?

There are in reality two processes and principles involved in Mr. Werk's operations, one of which is identical in every respect with that of the plaintiff.

9. Did you analyse an alleged specimen of defendant's process? If aye, from whom, and when did you receive it, and give your results?

I have analysed an alleged specimen obtained from defendant's process. I received it on the tenth of July, from Mr. B. C. Tilghman. The result of the analysis is as follows, viz:

22.99	per cent.	of water.
33.87	"	free or uncombined fatty acids.
40.34	"	neutral lime-soap.
2.30	"	glycerine.
0.50	"	impurities.

10. Have you read, and do you understand, the passage in A. Payen's Chemistry, (page 766,) referred to in defendant's answer?

I have read, and do understand, the passage in A. Payen's Chemistry, page 766, referred to in defendant's answer.

11. State whether the process described in Payen's Chemistry, is substantially the same as that described in plaintiff's patent; and point out in detail wherein said processes resemble or differ from each other, in principle and operation.

The processes mentioned in Payen's Chemistry differ altogether from that described in Mr. Tilghman's patent, in fact, show no resemblance to it at all. Mr. Tilghman's decomposes the fatty substances with hot water under pressure, in which no distillation whatever takes place,

into glycerine and fatty acids. Messrs. Dupuy, Bussy, and Le Canu, have shown that fatty substances can be decomposed by high temperature in several products, especially into fat acids, which pass off by distillation. No mention is made what becomes of the glycerine by that process. Messrs. Thomas & Laurent have made use of superheated steam in different operations in the arts. Monsieur Dubrunfaut showed that the fatty substances can be decomposed into fatty acids, by a current of steam at a high temperature. M. Fremy has published his researches on the so-called sulphuric acid saponification, and M. Masse and Tribouillet have made use of the labors of other people, and introduced them for manufacturing purposes.

12. How do the processes mentioned in Payen agree or differ from Tilghman's so far as concerns the use of pressure?

180 Neither of the processes mentioned in Payen uses pressure; whilst it is essential in the Tilghman process to use it.

13. Please state why pressure is essential in Tilghman's process.

Pressure is essential in Tilghman's process for the purpose of raising the temperature of the water to such a degree that it is able readily to decompose the fatty matters into fatty acids and glycerine.

14. How do the processes in Payen agree or differ from that of Tilghman, so far as relates to the use of close vessels?

In the processes mentioned in Payen vessels must be used in which the substances can be distilled; in other words, open vessels. In Mr. Tilghman's process any kind of vessel can be used, by which water can be made to act upon fatty substances at a high temperature under pressure.

15. Is or is not the difference between these processes, as to the use of close or open vessels, an essential difference necessarily resulting from the nature of the operations themselves?

Certainly, it is.

16. Have you read, and do you understand, the extract from Regnault's Chemisty, contained in Prof. Booth's answer to the 14th interrogatory, of his examination in this case, and do you confirm the accuracy of the translation of the said passage there given?

I have read it, and understand it, and confirm the accuracy of the translation.

17. State whether the process set forth in said work is substantially the same as that described in plaintiff's patent, and point out in detail wherein they resemble or differ from each other in principle and operation.

The process mentioned by Regnault is neither the same in principle nor operation as Mr. Tilghman's process. The principle of Regnault's process is a decomposition of the fatty substances, at a high temperature, into fatty acids, which are carried over into a receiver by a current of steam, and the destruction of the glycerine; whilst Mr. Tilghman's process is a decomposition of the fatty substances, by water at a high temperature and pressure, into fatty acids and glycerine, which latter remains dissolved in the water.

18. Have you seen in any published work a description of a process for the manufacture of a lime-soap in close vessels under pressure? If aye, name the work, and describe the process.

181 I have read a process of Monsieurs Milly and Motard, described in the Encyclopedia Roret, published at Paris in 1849, page 114, in which process the fats are saponified in a close vessel, under a pressure of about 30 lbs. to the inch, or of a temperature of 277° F.,

with a full dose of lime into a neutral lime-soap, which is proved from the fact mentioned in the same book, that the whole mass became gradually so consistent that it could not be stirred any more, and had to be dug out.

19. Please state how the process of Milly and Motard, which you have referred to, resembles or differs from that of the plaintiff.

It resembles that of the plaintiff, that they both use pressure in their operations; it differs from it in forming only a neutral lime-soap as a product, whilst the plaintiff decomposes the fatty substances into fatty acid and glycerine.

20. What is the nature of the chemical product formed in the *pro*-process described in Roret?

The process described in Roret forms a neutral lime-soap, a substance which contains, if no free lime be mixed with it, from 9 to 10 per cent. of lime, in intimate combination with the fatty acids, which latter cannot be extracted from it by solvents, like either, alcohol, &c., but only obtained by the decomposition of the said lime-soap with a more powerful acid, such as sulphuric acid, hydrochloric acid, and so forth.

21. In the process in Roret is there any free fat acid produced?

No, sir.

22. Is there anything in the description of the said process that would lead any one to suppose that free fat acid was produced, or was intended to be produced.

No sir; on the contrary, it distinctly mentions, when speaking of the quantity of lime which is to be added, "In sufficient quantity for the saponification of the fatty bodies," which means, that not a less quantity of lime should be added than that sufficient to form a neutral lime-soap.

23. What would be the quantity of lime, per hundred pounds of fat, requisite in practice to carry out the process described in Roret?

Where the process mentioned in Roret has been used, generally from 14 to 15 pounds of lime for 100 pounds of fat.

24. Have you seen in any published work a description of a process for the manufacture of common soap in close vessels under pressure? If aye, name the work and describe the process.

Yes, sir; I have. A process is described in a work called Repertory of Patent Inventions, new series, vol. xi, 1839, published in
182 London, by J. S. Hodson, and is known under the name of Arthur Dunn's patent, page 205 of said book. The process is essentially the same as the Milly and Motard process, with the difference only that Dunn uses soda as a saponifier, hence produces a soda-soap, whilst Milly and Motard produced a lime-soap.

25. In Dunn's process, as described, is there anything to lead any one to suppose that free fat acid was produced, or was intended to be produced?

No, sir. The Dunn's patent is taken out for making soap only. He uses the usual proportions of soda, that is, a sufficient quantity at least to make a neutral soda-soap, and it is not to be presumed he had any intentions for making fatty acids, nor could he make them under said circumstances.

26. From the knowledge obtained by you of the defendant's process from the answer filed, and his patent referred to therein, and your analyses of the alleged product of the defendant's process, please state minutely and in detail wherein the defendant's process embodies the features or principle of operation of plaintiff's patent.

The defendant uses in his process an apparatus capable of sustaining

a considerable amount of pressure, into which he places for one hundred pounds of fat about 130 pounds of water, and from 6 to 7 per cent. of lime. He afterwards heats up the apparatus by means of steam, or rather superheated steam, and by the pressure produced by his close vessel he gradually decomposes the fatty substances into neutral lime-soap and free fatty acids, the glycerine going into solution. We find, therefore, that the free fatty acids and glycerine resulting from the decomposition of the fatty bodies are obtained by the action of hot water under pressure, exactly as it is patented by Mr. Tilghman.

27. So far as the lime-soap in the defendant's product is concerned, state whether or not this lime-soap is produced by the process described in Roret.

Yes, sir. It is the same process practically and theoretically.

28. State whether or not two distinct chemical processes are concerned in the formation of the defendant's product, one for the production of the free fat acids portion thereof, and the other for the production of the neutral lime-soap portion thereof; and, if aye, identify these processes.

As already stated in answer to a previous question, two distinct processes are used in the defendant's process, namely, one for the production of free fatty acids, the other for the production of a neutral lime-soap; the latter being made on the same principle as stated in
183 Roret, to wit, a quantity of lime is used for saponification with water, under pressure; the quantity of lime, however, being insufficient to form with the whole amount of fatty acids, a neutral lime-soap only takes up as much of the fatty acids as is requisite for that purpose, the glycerine in part being liberated at the same time; the balance of the fatty matters not acted upon by the lime are decomposed by the hot water, under pressure, into fatty acids and glycerine, the same as in Mr. Tilghman's patent.

29. So far as relates to the chemical action involved in the formation of the free fat acids in the defendant's process, does it make any difference whether defendant's tank is heated by the introduction of superheated steam, or any other heating agent, such as common steam or a fire placed below said tank?

It does not make any difference whatever in defendant's process, whether he uses steam or superheated steam, or a fire placed under his tank.

30. In defendant's process, as described in his answer and patent, can the superheated steam used continue to exist in the state of superheated steam after it has passed into his tank, containing the quantity of water and other materials mentioned?

No, sir. As soon as the superheated steam enters his tank, the heat of the superheated steam is given up to the water and other material contained in his tank, until an equilibrium in temperature between his steam-boiler and his tank is established.

31. Is it or is it not a notorious fact, that water cannot be heated in a close vessel above 212° Fahrenheit, without the existence of a pressure in said close vessel corresponding to the temperature of the water?

Certainly; it is a notorious fact.

32. Please state whether or not the proof of the existence of free fat acids in defendant's product can be made by any simple and easy test; and if so, explain in what manner.

It can be proved very easily that the defendant's product contains about one half of the fatty acids in the free or uncombined state, by extracting the same with solvents, such as æther, alcohol, and various

hydro-carbons, which would not have a decomposing influence if it was in combination with the lime present. The fat acids thus extracted were obtained in the pure state by spontaneous evaporation of the æther or alcohol employed, and gave, with tests, a re-action of no other substance but fatty acids. They show a distinct reddening of litmus paper and combined with alkalies forming neutral soaps.

184 33. Have you read the testimony taken on the part of defendant in this case in Cincinnati? If aye, state whether the use by the witnesses, Wayne and Grasselli, of the term "acid lime soap," to describe the defendant's product, is a proper chemical description of said product; and give your reasons.

The term acid lime-soap which has been mentioned in the testimony of Messrs. Wayne and Grasselli, which I have read, is an improper term. First. Because we can extract, as shown in the above experiments, the free fatty acid contained in Mr. Werk's product, by solvents like æther, chloroform, &c. It can, therefore, not be in intimate chemical combination with the neutral lime-soap. Secondly. We do not know in chemistry a compound called "acid lime-soap," and the statement of Mr. Wayne, therefore, is nothing else than an assertion without proof. The same is the case when he calls stearic acid a tribaric one, and thus intending to prove by substitution of a portion of water in the place of lime, that such a substance as an "acid lime-soap" might exist.

34. As compared with the processes of manufacturing fat acids, commonly employed prior to Mr. Tilghman's patent, by using about fourteen pounds of lime and 36 pounds of sulphuric acid with 100 pounds of fat, does or does not the process patented by Mr. Tilghman show a reduction in the quantity of lime employed to zero, or a small comparative amount?

Yes, sir.

35. Does or does not the said process of Tilghman show a reduction in the quantity of sulphuric acid to be employed, corresponding to the reduction in the quantity of lime?

It does.

36. In the said process of Tilghman, is or is not the reduction in the amount of lime and sulphuric acid due to the employment of the chemical power of highly-heated water?

Yes, sir; it is.

37. Do you find in any of the processes mentioned or described, as being prior in date to that of Mr. Tilghman, any declaration of the fact, that, by the employment of the chemical power of highly-heated water, the whole or a portion of the lime and sulphuric acid heretofore used in the manufacture of fat acids could be dispensed with?

I do not.

185 38. As compared with the old processes of using 14 pounds of lime and 36 pounds of sulphuric acid to the 100 pounds of fat, does or does not the process of the defendant show a reduction of the quantity of the lime and sulphuric acid employed?

Certainly; the defendant using about half the quantity of lime which manufacturers were in the habit of using prior to Mr. Tilghman's patent, he, as a matter of course, saves one half of the amount of sulphuric acid formerly necessary for the separation of the lime.

39. Is or is not this reduction of the quantity of lime and sulphuric acid in defendant's process due to the fact that the chemical power of highly-heated water is employed to decompose the fat?

Certainly; it is.

40. Is or is not the action of chemical power of highly-heated water in

defendant's process and in Mr. Tilghman's process identically the same?

Yes, sir; they are identical.

41. Is or is not the employment of this chemical power of highly-heated water the characteristic feature of Mr. Tilghman's process, as patented?

Certainly; it is the main feature of the whole process.

42. From your knowledge of chemistry, who, should you say, was the discoverer of the chemical power of water in a liquid state at a high temperature on fats to produce acids and glycerine?

(Mr. Fox objects as illegal.)

From my knowledge of chemistry, Mr. R. A. Tilghman is considered the discoverer of the decomposing action of highly-heated water upon fats, by which they are converted into fatty acids and glycerine.

43. Is or is not this discovery regarded as a new and important fact in chemistry?

Yes; it is.

Adjourned until to-morrow at 10½.

186 TUESDAY, 31*st July*, 1860.

Present, Mr. Harding and Mr. Fox.

The examination proceeds.

Cross-examined by Mr. Fox, for defendant:

44. Have not close steam-tight tanks been known to be used for melting fatty substances, both with and without the use of water?

I suppose they have been in use for melting fatty substances.

45. Have you, by any experiment in your laboratory, ever produced a separation of fatty substances into glycerine and free fat acids, by the use of highly-heated water alone? If aye, when and what degree of heat did it require to produce the result?

My laboratory is more of an analytical laboratory than one in which experiments can be made on a large scale like those referred to by Mr. Fox. I, therefore, have not.

46. Have you ever been requested by Mr. Tilghman to make such an experiment? Have you not analysed a specimen of the soap made by Mr. Werk, at the request of Mr. Tilghman? How long have you been engaged, if at all, in experimenting for Mr. Tilghman?

I have not been requested by Mr. Tilghman to make such an experiment. I have not analysed a soap at the request of Mr. Tilghman, but a substance consisting of a soap and free fatty acids. I have made experiments with that soapy substance from the tenth instant to the twenty-seventh.

47. Do you understand that a lime-soap, produced in the way the defendant produces it, by superheated steam and lime, contains no fat acid?

The defendant does not produce by his process a lime-soap, at all, but a mixture of a lime-soap and free fatty acids.

48. Are they in combination, or separate?

If I speak of free fatty acids, I mean fatty acids that are not in combination, but separate.

49. Are you acquainted with the work called the Chemical Gazette, published in London?

(The plaintiff objects.)

Have you read No. 318, for January, 1856? Is there not in that number an article on the saponification of neutral fatty bodies, by soaps, by M. J. Pelouse, in which it is stated that one of the oldest manufacturers of

mould candles communicated to the jury of universal exposition
187 an important modification of the process of saponification of fatty bodies? Is it not there stated that the proportion of lime necessary for saponification, which he had long reduced from 15 to 8 or 9 per cent. of the fatty matter, might be further diminished by half, and reduced to only 4 per cent., merely by exposing the mixture of lime, water, and fatty matters to a high temperature? Do you consider this last work as describing different modes of producing free fat acids and glycerine, by the use of highly-heated water, and also by steam, with a very small share of lime?

I am acquainted with the Chemical Gazette, published in London, in No. 318 of which (for January, 1856) M. J. Pelouse speaks of a saponification of neutral fatty bodies by soaps. I do consider his paper as describing the decomposition of fats by highly-heated water, solely under pressure, into fat acids and glycerine, as patented almost two years previous by Mr. Tilghman.

50. Independently of what the witnesses have testified in this case, do you know anything practically about the making of free fat acids and glycerine from fatty substances by the use of highly-heated water alone? Have you seen the process in operation; and if so, when, and where?

I know the process from consulting the works on chemistry, but I have not practically worked with said process, and I have not seen the process in operation.

51. What do you call high temperature of water when applied to the separation of fatty substances into free fat acids and glycerine? How high a heat do you consider necessary to produce the separation, where no lime or other base is used?

I believe that any degree of heat which requires pressure for obtaining will be able to make water act upon fatty substances, decomposing them into fatty acids and glycerine, if you only allow them to act long enough. I therefore consider the high temperature of water, any which can be obtained only under pressure, any degree above 212° Fa'renheit.

52. How long do you suppose it would take to produce a complete separation at a heat of 300° F., and how long at a heat of 650° F.?

That can be found out very easily by experiment. I have not made such experiment.

53. Cannot you determine the temperature necessary to separate the free fat acids and glycerine by heated water alone by reading the patent and specifications of Mr. Tilghman?

It is impossible to determine the exact temperature for the decomposition of fatty bodies by referring to Mr. Tilghman's patent, because, as he states in the same, different fatty bodies require different temperatures for their decomposition. He recommends, therefore, to
188 start the apparatus at a low heat, gradually increasing the temperature until it gives the best results for the intended decomposition. He recommends the melting point of lead only as a convenient temperature for the decomposition of fat, stating, however, that a higher temperature may be used without danger.

54. Is there such a difference in the composition of fatty substances, usually employed in the United States to produce stearic acid, as to vary the necessary temperature required more than a few degrees?

So it appears; the differences in the composition of fatty substances usually employed in the United States is merely a difference in the percentage of margaric, stearic, and oleic acids, with glycerine. I might call it a difference in degrees. It requires, therefore, different degrees

of temperature to give the best result for each of these substances employed. By this I mean to say that the same temperature might be employed for either, and a variation in the degree of heat will not alter but only facilitate the operation.

55. Please name the different fatty substances usually used by manufacturers of stearic candles in the United States?

The different fatty substances from animals, such as suet, lard, cotton-seed oil, etc.

56. You think Mr. Tilghman the discoverer of the fact that highly-heated water will produce a separation of free fat acids and glycerine? Are you sure it will do so in the manufacture in as rapid a manner as in the old process? How long will it take, in your opinion, by the use of heated water alone, to produce the separation?

Mr. Tilghman is the acknowledged discoverer of the fact that highly-heated water produces the separation of glycerine and free fatty acids from fatty substances. The testimony given in Cincinnati proves that it produces these substances in a far shorter time than can be done by the old process, and this appears to me, also, by carefully examining his patent, a result which is by no means surprising.

57. Do you mean to say that, notwithstanding what is said in Payen's, Regnault, Roret, and the Repertory and other works you have read, you would not, as a chemist, be able to understand that by the use of highly-heated water alone fatty substances could be separated into free fat acids and glycerine?

In neither of these works the least shadow of an idea is given with reference to the action of highly-heated water on fatty substances, and I find that the first clear expression of this fact was stated by Mr. R. A. Tilghman. I therefore could not, by consulting the works above referred to, conceive the idea that fatty substances were decomposed in that manner.

F. A. GENTH.

189 UNITED STATES,

Eastern District of Pennsylvania, set:

Be it remembered that, on the twenty-sixth day of July, A. D. 1860, personally appeared at my office, United States courts, No. 104 South Fifth street, in the city of Philadelphia, before me, Charles F. Heazlitt, a commissioner appointed by the circuit court of the United States in and for the eastern district of Pennsylvania, in the third circuit, under the laws of the United States, to take affidavits and acknowledgments of bail, &c., Benjamin C. Tilghman, to testify, and the truth to say, on the part and behalf of the plaintiff, in a certain suit or matter of controversy now depending and undetermined in the circuit court of the United States in and for the southern district of Ohio, wherein Richard A. Tilghman is the plaintiff and Michael Werk is the defendant; and the said witness, being of lawful age, and having been by me first cautioned and sworn to testify the truth, the whole truth, and nothing but the truth in the matter of controversy aforesaid, thereupon the examination of said witness was continued until the 31st day of July, 1860, at 11 o'clock a. m.; on which said 31st day of July, A. D. 1860, present Mr. Harding and Mr. Fox, the examination of said witness is proceeded with, and he did thereupon depose, testify, and say, as follows:

My name is Benjamin C. Tilghman; reside in the city of Philadelphia; aged 38 years, and am an experimental chemist. I am the brother of the plaintiff, and am interested in the event of this suit. I was in Cincinnati in the beginning of the year 1860, for the purpose of attend-

ing to the interests of the plaintiff, in connection with his patent, and with this suit. As agent for plaintiff I requested the defendant to furnish me with a sample of his product, stating that it was for the purpose of having an analysis made by chemical experts. I received from defendant, in the presence of his counsel, Mr. Fox, a small bottle closely corked, containing about six ounces of an alleged sample of defendant's product, and labelled as such. I retained this bottle in my possession, and about the middle of June, 1860, I delivered it, in the same condition in which I had received it, to Professor Booth, in Philadelphia, for the purpose of analysis. Shortly after I received this sample I asked the defendant to give me another sample, rather larger in quantity, for the same purpose. He agreed to give it, and I received at his office in Main street, Cincinnati, a closely-corked bottle, containing about one pound of an alleged sample of his product.

This bottle I retained in my possession till I was about to leave Cincinnati in the month of April, 1860. I then put this bottle into a wooden box, and nailed it up, and directed it to my address in Philadelphia. I afterwards received this box in Philadelphia through a forwarding company, and found the bottle in the same condition as when I had put it into the box. I retained this bottle in my possession, and in the month of July, 1860, I gave a portion of its contents to Professor Robert E. Rogers, in order to compare the results of its analysis with those of another analysis he had made. I afterwards gave another portion of the contents of this bottle to Dr. Frederick A. Genth to be analysed. From a chemical examination made by me of the contents of the two bottles above referred to, I am satisfied that the contents of the latter bottle, when I delivered portions of them to Professor Rogers and Dr. Genth, were substantially the same substance as that contained in the smaller bottle just mentioned.

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I still retain in my possession the larger bottle, with the rest of its contents.

Cross-examination declined.

B. C. TILGHMAN.

Translation from Regnault, (section 1594, vol. 4, p. 386.)

"The chemical operations by which natural fatty matters are transformed into glycerine and fat acids have the general name of saponification. They are of different kinds. Saponification of fat may be effected in fact either by alkali or by strong acids, or even by the action of heat alone. If the fats are heated to a temperature of 572° Fahrenheit, in an apparatus, through which a current of steam is passed at a lower pressure than that of the atmosphere, the glycerine is destroyed, and converted into several products soluble in water, and the fat acids becoming free, distil without change; thus saponification by heat alone has been attained."

Translation from Payen, (p. 766.)

"The remarkable labors of several learned men and manufacturers have given birth to this new branch of industry; after the discoveries of M. Chevreul on the constitution of the fatty bodies, MM. Dupuy, Bussy, and Lecannu proved, in 1840, that these bodies can be decomposed under the influence of temperature into several products, and especially transformed into fat acids, which pass over by the distillation. MM. Thomas and Laurent applied superheated steam to various

manufacturing operations. In 1841 M. Dubrunfaut conceived the idea of obtaining the fat acids on a manufacturing scale by decomposing the fats by a current of steam at a high temperature. A few years since M. Fremy published the results of precise researches on the sulphuric saponification. Finally MM. Mass and Tribuillet, taking advantage of these observations, laid the foundation of the remarkable manufacture we are about to describe by the aid of new processes and ingenious apparatus."

191 *Translation of a passage in Roret's Encyclopedie, (pages* 113, 114, *and* 115.*)*

Another useful observation is presented, viz., that the saponification of fats by lime can scarcely be executed rapidly and completely, except under a pressure greater than that of the atmosphere. It was believed for a long time that saponification by lime could only be effected in closed boilers; and, although it has been since ascertained that increased pressure and consequently increased temperature are not indispensable for this saponification, it is quite possible that in returning to the former opinion we may effect an important diminution in the proportion of lime required for a given weight of fat.

This idea, however, is not novel: for it was announced in the patent of Gay-Lussac & Chevreul, (reported above,) and has been repeatedly taken up by manufacturers, and we do not know why it has been abandoned. We will quote, for example, the process of saponifying fats, patented to Milly & Motard, in 1834, and described in vol. LII., page 505, of the "Brevets d'Invention," from which the following is extracted:

"The boiler employed by the inventors is of a cylindrical form, its upper part terminating in a man-hole hermetrically closed by a bolted cover. This cover has in its centre a stuffing-box through which passes a stirring-rod with a cross-piece of wood on its lower end. Another hole in the cover is for a tube which plunges some six inches into the boiler, and which is to contain a thermometer.

"The boiler is heated by a furnace of usual construction.

"Water is first run into the boiler, equal about to twice the weight of fat to be saponified; the fat is then introduced, and, when it is melted, milk or lime sufficient for the saponification of the fat is run over the liquid mass. The boiler is then closed, and the liquid stirred at short intervals by raising and lowering the stirring-rod or plunger. This operation is continued until the thermometer marks 277° Fahr., (136° centigrade.) As the whole mass becomes stiff after a certain time, agitation is no longer practicable; the operation is left to itself and ceases with the diminution of the temperature. When the thermometer only shows 212° Fahr., the boiler is opened, and emptied by the man-hole as soon as it is sufficiently cooled."

JA'S C. BOOTH.

192 In the circuit court of the United States for the southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK.

Depositions of witnesses produced, sworn, or affirmed, and examined on behalf of the plaintiff in the above case, before Charles F. Heazlitt, U. S. commissioner at Philadelphia, pursuant to notice hereto annexed.

AUGUST 27TH, 1860.—Present, Mr. Harding. Adjourned till to-morrow at 10 a. m.

AUGUST 28TH, 1860.—Present, Mr. Harding. Adjourned till to-morrow at 10 a. m.

AUGUST 29TH, 1860.—Present, Mr. Harding. Adjourned till to-morrow at 10 a. m.

AUGUST 30, 1860.—Present, Mr. Harding. Adjourned till to-morrow at 10 a. m.

AUGUST 31, 1860.—Present, Mr. Harding. Adjourned till to-morrow at 10 a. m.

SEPTEMBER 1, 1860.—Present, Mr. Harding. Adjourned till Monday next, at 10 a. m.

193 UNITED STATES,
Eastern District of Pennsylvania, set:

Be it remembered that, on the third day of September, anno Domini 1860, personally appeared at my office, U. S. courts, No. 104 South Fifth street, in the city of Philadelphia, before me, Charles F. Heazlitt, a commissioner appointed by the circuit court of the United States in and for the eastern district of Pennsylvania, in the third circuit, under the laws of the United States, to take affidavits and acknowledgments of bail, &c., William M. Tilghman, to testify and the truth to say on the part and behalf of the plaintiff, in a certain suit or matter of controversy now depending and undetermined in the circuit court of the United States in and for the southern district of Ohio, wherein Richard A. Tilghman, the plaintiff, and Michael Werk is the defendant; and the said witness, being of lawful age, and having been by me first cautioned and sworn to testify to the truth, the whole truth, and nothing but the truth in the matter of controversy aforesaid, did thereupon depose, testify, and say, as follows, viz:

1. What is your name, age, residence, and profession?

William M. Tilghman; aged 44 years; reside in the city of Philadelphia, and by profession attorney at law.

2. Can you state at what time the plaintiff left the United States on his last visit to Europe, and when he returned therefrom to the United States?

I can. I am a brother of the plaintiff, and have had occasion to bear in mind the dates referred to. He left Philadelphia for England in the month of December, 1853, and returned in September, 1858. I corresponded with him during the whole period of his absence.

W. M. TILGHMAN.

UNITED STATES,
Eastern District of Pennsylvansa, set:

Be it remembered that, on the third day of September, anno Domini 1860, personally appeared at my office, U. S. courts, No. 104 South Fifth street, in the city of Philadelphia, before me, Charles F. Heazlitt, a commissioner appointed by the circuit court *af* the United States in and for the eastern district of Pennsylvania, in the third circuit, under the laws of the United States, to take affidavits and acknowledgment of bail, &c., Frederick A. Genth, to testify and the truth to say on the part and behalf of the plaintiff, in a certain suit or matter of controversy
194 now depending and undetermined in the circuit court of the United States for the southern district of Ohio, wherein Richard A. Tilghman, the plaintiff, and Michael Werk is the defendant; and the

said witness being of lawful age, and having been by me first cautioned and sworn to testify the truth, the whole truth, and nothing but the truth in the matter of controversy aforesaid, did thereupon depose, testify, and say as follows, viz:

1. What is your name, age, residence, and profession, and how long have you been engaged in such profession?

My name is Frederick A. Genth; 40 years of age; by profession a chemist, and have been engaged as such since 1839.

2. Have you made any experiments on the action of water at high temperatures and pressures upon fats? If yea, state when and where; what were the temperatures employed, the length of time used, and what the results produced? If you have any samples of the products of such experiments please deposit them in the hands of the commissioner.

I have made such experiments between the 13th and 18th August, 1860, in the laboratory of Professor Booth. There were two experiments, one at a temperature of 320° F. One during eleven hours, and the other during twenty hours; and the third experiment was made at the temperature of 612° F., during five minutes. The results produced were—1st, at an experiment during eleven hours, at a temperature 320°, fat, with about double the quantity of water, was decomposed at least to four-fifths into glycerine and free fatty acids. This experiment is marked No. 1, A, (C. F. H.) I mean four-fifths of the fat which was placed in the vessel was decomposed into free fatty acids.

After the samples for experimenting had been taken out from the vessel, the fatty portion of the experiment was again placed into the same vessel, with about double the quantity of water, and heated during thirteen hours, at a temperature of 320°. The fat, therefore, was exposed at that high temperature during twenty-four hours. The result of this decomposition was the complete conversion of the fat remaining from the first experiment into free fatty acids and glycerine. The sample of free fatty acids obtained by this experiment is marked No. 1, B, (C. F. H.)

The third experiment above alluded to was made by placing fat with double the quantity of water into an apparatus in such a manner, however, that both were heated at first, separately, to a temperature of 612° F., and after this temperature was reached both were mixed and heated for five minutes at the same temperature. The apparatus was then rapidly cooled down and some of the contents taken out for examination. The result of this examination was that the fat was completely converted into glycerine and free fatty acids. Samples of which, marked No. 3, (C. F. H.) is now produced.

195 3. Have you made any experiments on the action of water and different proportions of lime at high temperatures and pressures upon fats? If yea, state when and where; describe the experiments in detail and the results produced. If you have any samples of the products of those experiments, please deposit them in the hands of the commissioner.

I have made experiments at high temperatures and pressures with water and different proportions of lime upon fats. These were made during the same period mentioned above, at Professor Booth's laboratory. The first experiment made with lime was made in the following manner: Lard, with double the quantity of water, and one-half per cent. of lime, were exposed, during twelve hours, to a temperature of 320° Fahr., in an inclosed vessel. The examination of the contents of this vessel proved that the water contained the glycerine; a small quantity

of lime-soap was formed and free fatty acid. The free fatty acid obtained by this experiment I now produce, marked No. 2, (C. F. H.) The fatty acid was obtained from the fatty portion of the experiment by extraction with cold alcohol.

The second experiment was made by placing fat in the proportion of 100 with 130 parts of water and 6½ parts of lime into a vessel and treating the same during six hours at a temperature of 350° Fahr. The results were, the liquid contained the glycerine, and the fatty portion a mixture of lime-soap and free fatty acids, samples of which, marked No. 4, (C. F. H.,) *is* now produced. These were obtained in the following manner: Lime-soap being insoluble in alcohol, and free fatty acids being easily dissolved by this agent, the mixture of the two was treated by cold alcohol, and separated by filtration. Into the alcoholic solution a large quantity of boiling water was poured, and the whole stirred, by which the fatty acids were separated from the alcoholic solution; the residue remaining unfiltered was tested, and found to be lime-soap, and is contained in sample No. 4, (C. F. H.)

The third experiment with lime was made by placing lard, water, and lime in the proportion of 100 fat, 130 water, and 12 of lime, into a vessel, which was heated during six hours at 350° Fahr. The result of this experiment was water containing glycerine and lime-soap; the latter by being treated with alcohol in the same manner as No. 4, did not yield any free fatty acids at all.

4. Was the experiment which you have described as made with 6½ per cent. of lime made under the same conditions, as to proportion of materials and temperature, as is stated by the defendant in his answer to be employed by him?

Yes, sir.

5. Can you state, from your own knowledge, whether or not free fat acids are formed under those conditions set forth and described in the defendant's answer?

196 I can state, from my own knowledge, that free fat acids are formed under these circumstances.

6. State whether or not the free fat acids made under the circumstances referred to in interrogatory 4 can be separated from the lime-soap without the use of any acid; and, if so, describe in detail the chemical mode of effecting such separation.

The free fat acids can be separated from such mixture without the use of any acids, and can be easily obtained by shaking the dry substance with three or four times its bulk of cold alcohol, filtering off the liquid portion, and either evaporating the alcohol over a water-bath, by which the fatty acids remain behind, or, more rapidly, by pouring into the alcoholic solution eight or ten times its bulk of boiling water, by which the fatty acids are separated, and swim on the heavier solution or mixture of water and alcohol. That this substance is, in reality, free fatty acids can be easily proved by testing the alcoholic solution with litmus, and also by showing the affinity with which it combines with alkaline bases. The substance remaining unfiltered is lime-soap, or neutral lime-soap, as it has been called. This distinction, however, is improper, because there is no other lime-soap but a neutral one.

7. Was or was not the experiment you have referred to as made with 12 per cent. of lime made under substantially the same chemical conditions as that described in Roret's Encyclopedia and Dunn's patent? From your own experience, and from your scientific knowledge, can you speak positively as to whether or not any free fat-acid is formed, or can

possibly be formed, in the processes described in Roret and Dunn's patent?

Said experiment was made under the same chemical conditions as described in Roret's Encyclopedia and Dunn's patent.

From the experiments made in Professor Booth's laboratory I know that the water obtained by the formation of the lime-soap, made under the same conditions as above stated, is quite alkaline; the substance, therefore, cannot contain any free fat acids, because the excess of lime would combine with the same; and, since in the processes described in Roret and in Dunn's patent always an excess of alkali is used, and sufficient time given for combination, it is an impossibility that free fat acids can be formed under such circumstances.

8. Referring to the article in the Chemical Gazette, vol. 14, p. 28, to which your attention was directed by defendant's cross-interrogatory, No. 49 of your former examination, can you state, from your own knowledge and experiments, whether or not the statement is true or false, in the following words?

"I have also ascertained that, at a temperature of 329° Fahr., water does not act upon oils. To split them, it is necessary that the
197 mixture of fatty matter and water should attain and retain, for a very long time, the temperature of 428° Fahr., assigned by M. Berthelot for this latter saponification."

I can, from my own knowledge and experiments, say that the statement of Mr. Pelouze is false, because even below that temperature mentioned oils or fats in general are completely converted into free fat acids and glycerine by the action of water, as proved by the samples produced on this examination, marked No. 1, A, (C. F. H,) and No. 1, B, (C. F. H.)

9. Have you made any experiment to prove whether the theory proposed in said article is true or false as contained in the following extract from said work, to wit:

"In the new reactions just mentioned we can understand that water, at a temperature of 302° to 320° Fahr., may decompose a neutral soap into an acid soap, and a very basic soap, and that the latter acts secondarily upon a new quantity of fatty matter, in the same way as a free alkali."

I have made such experiments, and can state that the conclusions of Mr. Pelouze are incorrect; for no action as that described takes place. A quantity of lime soap, with water, was placed in a vessel, and heated during six hours to a temperature of 350°; the contents were afterwards examined, and the substance found to be the same as before; in other words, it was not split into an acid soap and a very basic soap.

10. Judging from your own experiments, taken in connection with your general scientific knowledge, please point out wherein plaintiff's process resembles or differ' from the processes described in Payen, in Regnault, Roret's Encyclopædia, Dunn's patent, and in defendant's answer, as to the conditions necessary, the results produced, and the action which takes place in these processes respectively.

In Tilghman's process the conditions necessary are—first, the presence of fat to be acted upon; secondly, the presence of water at a high temperature and under pressure; thirdly, the absence of lime or other alkali, either entirely or to such an extent as to leave a portion of the fat without any equivalent of saponifying material. The results are—first, the production of glycerine; secondly, the production of free fatty acids. The action is, water heated to such a high temperature under pressure separates the glycerine from the fat, and at the same time liberates the fatty acids, which thus become free.

In the processes described by Payen and Regnault, the conditions necessary are—first, fat to be heated to 572° Fahr., in an open vessel, by which the possibility of the presence of water in a liquid state is excluded; secondly, a current of steam, superheated or not, to carry over the vapors of fatty acids. The results are—first, production of free
198 fatty acids; secondly, destruction of the glycerine into acroleine, or other products of decomposition; thirdly, a certain quantity of a tarry residue, resulting from the destruction of a portion of the fat. The action is, in the act of distillation at the above temperature the glycerine is destroyed, and fatty acids are set free and pass over in the state of vapor, mixed with steam, into the condenser, where both fatty acids and steam are condensed into liquid form.

Tilghman's process, therefore, differs from those of Payen and Regnault's in the conditions necessary, and in the production of glycerine, and in the action which takes place; it resembles those of Payen and Regnault's only in the one fact, that free fatty acids are produced.

The processes described in Roret's Encyclopædia, (Mills & Motard's patent,) and in the Reportory of Patent Inventions, (Dunn's patent,) the conditions necessary are—first, the presence of fat; secondly, the presence of water, heated to 300° and upwards, under corresponding pressure; thirdly, a presence of lime and other alkali in full quantity, sufficient to combine with all the fatty acids of the fat. The results are—first, a production of glycerine, the production of a neutral soap, lime-soap, or soda-soap, respectively.

The action is, the lime or other alkali combines with the fatty acids of the fat, and forms a neutral soap, thus liberating the glycerine, which dissolves in the water present.

Tilghman's process resembles Milly's & Dunn's in the conditions necessary: water, heated under pressure, and a production of glycerine; it differs from them in the absence of lime or other alkali, either entirely or to such an extent as to leave a portion of the fat without any saponifying material, in the production of free fatty acids, and in the chemical action which takes place.

In defendant's process, as described in his answer, the conditions necessary are—first, the presence of fat; secondly, the presence of water, heated to 350° Fahrenheit in a close vessel; third, the presence of lime in quantity sufficient to combine with only a portion of the fatty acids of the fat, but insufficient to combine with the whole quantity of the same. The results are—first, production of glycerine; secondly, production of neutral lime-soap, in quantity corresponding to the lime present; thirdly, the production of free fatty acids in quantity corresponding to the fat present, without lime to combine with fatty acids of the same. The action is, the lime combines with a portion of the fat, forming a lime-soap, and separating the glycerine, as in Milly's patent or process; the water combines with the other portion of the fat, separating glycerine and fatty acids, as in Tilghman's process. Defendant's process resembles Tilghman's in the conditions, results, and actions concerned
199 in the production of a fatty acid portion of the substance. It differs from Tilghman's, and resembles Milly's process, in the conditions, results, and actions concerned in the formation of the lime-soap portion of the product.

10. Can you furnish, in a tabular form, a statement of the principal points of resemblance and difference, between plaintiff's process, and the other processes you have mentioned?

Yes, I can, and will proceed to do so.

TILGHMAN'S PROCESS.	PAYEN & REGNAULT.
1. Presence of water, heated under pressure, essentially necessary.	1. Presence of water, heated under pressure, (or water in a liquid state,) impossible.
2. Glycerine produced.	2. Glycerine destroyed.
3. Acroleine is not produced.	3. Acroleine is produced.
4. Fatty acids are not converted into vapor.	4. Fatty acids are converted into vapor.
5. Close vessels essentially necessary.	2. Open vessels essentially necessary.
6. No tarry substance is formed.	6. Tarry substance is formed.

TILGHMAN'S PROCESS.	MILLY & DUNN.
1. The absence of lime or other alkali, in quantity sufficient to combine with all the fatty acids of the fat, is essentially necessary, so as to leave a part of the same without any lime or other saponifying material.	1. The presence of enough lime or other alkali, to combine with the whole amount of fatty acids in the fat, is essentially neces sary.
2. Produces free fatty acids.	2. Produce neutral lime or soda soap, and no free fatty acids.

TILGHMAN'S PROCESS.	DEFENDANT'S (WERK) PROCESS.
	1. Two processes employed, as to different portions of the fat: A. As to one portion—presence of water, fat and lime, enough to combine with all the fatty acids of that portion of the fat. B. As to the other portion—presence of fat and water, without any lime, to combine with that portion of the fat.
1. Presence of fat and water at high temperature and pressure.	
2. Produces free fatty acids.	2. The "A" portion produces lime-soap; the B portion produces free fatty acids.

MILLY & DUNN.	WERK.
1. Use lime, or other alkali, in sufficient quantity to combine with all the fatty acids of the fat.	1. Does not use enough lime to combine with all the fatty acids of the fat.
2. Produce neutral lime or soda soap, and do not produce any free fatty acids.	2. Produces a portion of neutral lime soap, and a portion of free fatty acids.

200 PAYEN & REGNAULT.	WERK.
1. The presence of water, heated under pressure, impossible.	1. The presence of water, heated under pressure, essentially necessary.
2. Open vessel used.	2. Closed vessels essentially necessary.
3. Glycerine destroyed, and acroleine produced.	3. Glycerine, but no acroleine produced.
4. Fatty acids converted into vapor.	4. Fatty acids not converted into vapor.
5. Tarry substance formed.	5. No tarry substance formed.
6. Superheated steam is used, without pressure, for the purpose of carrying over the vapors of the fatty acids into the condenser.	6. Superheated steam is used, with pressure, for the purpose of heating up the liquid water and fat.

F. A. GENTH.

UNITED STATES,
Eastern District of Pennsylvania, set:

Be it remembered that, on the fourth day of September, A. D. 1860, personally appeared at my office, United States courts, No. 104 South Fifth streets, in the city of Philadelphia, before me, Charles F. Heazlitt, a commissioner appointed by the circuit court of the United States in and for the eastern district of Pennsylvania, in the third circuit,

under the laws of the United States, to take affidavits and acknowledgments of bail, &c., James C. Booth, to testify, and the truth to say on the part and behalf of the plaintiff, in a certain suit or matter of controversy now depending and undetermined, in the circuit court of the United States for the southern district of Ohio, wherein Richard A. Tilghman is the plaintiff, and Michael Werk is the defendant.

And the said witness being of lawful age, and having been by me first cautioned and sworn to testify the truth, the whole truth, and nothing but the truth, in the matter of controversy aforesaid, did thereupon depose, testify, and say, as follows, viz:

1. What is your name, age, residence, and profession, and how long have you been engaged in such profession?

James C. Booth; age, about 50 years; by profession, chemist; and have been so engaged since 1835.

2. Have you made any experiments on the action of water at high temperatures, and pressures upon fats? If yea, state when and where. Describe the experiments in detail, and describe the results produced. If you have any sample of the products of those experiments, please deposit them in the hands of the commissioner.

201 I made two experiments on the action of heated water on fats, in my laboratory, in August, 1860. The first experiment, lard was heated, with twice its weight of water, to 320° F., during eleven (11) hours. All the water was drawn off, and a small amount of fatty matter; the water contained glycerine, a sample of which is produced, marked No. 1, A, (C. F. H.,) and the quantity of glycerine proved that more than four-fifths of the lard had been resolved into fat acid and glycerine. A sample of the fatty product thus obtained is herewith presented, marked No. 1, A., (C. F. H.) Its highly acid character is proved by its hardness, as compared with the lard, by its cristal'ization, by its decomposing carbonate of alkali, by its great solubility in alcohol, and the fact that this alcoholic solution reddens an alcoholic solution of litmus. A sample of the lard used in the preceeding and following described experiments is herewith presented, marked 1, C., (C. F. H.) The fatty product was again heated, with twice its weight of fresh water, to 320° F., for thirteen hours more, making the total length of time, during which it was heated to 320° F., twenty-four hours. The lard had then been wholly resolved into fat acids and glycerine. The fat acid thus obtained is herewith presented, marked No. 1, B., (C. F. H.)

In the second experiment the lard was heated, with twice its weight of water, to 612° F., during five minutes, it having required twenty-five minutes to heat the tube up to 612° F.; the materials contained in the tube, which was thus heated, were kept separate until the temperature of 612° had been attained, when they were mixed by agitation, and heated at that temperature during five minutes. The lard was wholly resolved into fat acids and glycerine, samples of which are produced, marked No. 3, fat acids, and No. 3, glycerine, (C. F. H.)

3. Have you made any experiments on the action of water and different proportions of lime at high temperatures and pressures upon fats? If yea, state when and where. Describe in detail the experiments made, and the results produced. If you have any samples of the products of those experiments, please deposit them in the hands of the commissioner.

I have made three experiments at the same time and the same place as stated in my last answer. In the first experiment, water was heated with half its weight of lard, and one-half per cent. of lime, compared with the weight of the lard, to 320° F., during twelve hours. The lard

was resolved into fat acids, lime-soap, and glycerine; the fatty product treated by alcohol gave a solution of fat acids, and left the lime-soap undissolved, samples of which are here presented, marked No. 2, (C. F. H.) The alcoholic solution, by evaporation, yielded the fat acids.

In the second experiment, one hundred parts of lard were heated with one hundred and thirty parts of water, and six and one-half parts of lime, to 350° F., during six hours. The fatty product thus ob-
202 tained is herewith presented, and marked No. 4, (C. F. H.) Part of this product, treated by alcohol, gave a solution of free fat acids, leaving lime-soap undissolved. Samples of these produced are herewith presented, marked No. 4, lime-soap; No. 4, fat acid, (C. F. H.)

In the third experiment, one hundred parts of lard were heated, with one hundred and thirty parts water, and twelve parts lime, to 350° F., for six hours. The lard was wholly resolved into lime-soap and glycerine. A sample of the product of this action is herewith presented, marked No. 6, (C. F. H.) Alcohol did not extract a trace of free fat acid from the product, proving the total conversion of the fat into lime-soap.

4. Was the experiment, which you have described as made with 6½ per cent. of lime, made under the same conditions, as to proportion of materials and temperature, as is stated by the defendant, in his answer, to be employed by him?

It was.

5. Can you state, from your own knowledge, whether or not free fat acids are formed under the conditions described and set forth in the defendant's answer?

Free fat acids are necessarily formed under the conditions stated in his answer.

6. State your opinion as to whether or not the free fat acids so formed are produced by the chemical action of water at a high temperature, and pressure on fat, as set forth in the plaintiff's patent.

The free fat acids thus produced are exclusively produced by the action of water, as set forth in the plaintiff's patent.

7. Was or was not the experiment you have referred to, as made with 12 per cent. of lime, made under substantially the same chemical conditions as that described in Roret's Encyclopædia, and Dunn's patent? From your own experience, and from your scientific knowledge, can you speak positively as to whether or not any free fat acid is formed, or can possibly be formed, in the process described in Roret, and Dunn's patent?

The experiment was made under the same conditions, time, temperature, and proportion of materials.

I could obtain no fat acid from the product, and affirm, on chemical principles, that it is impossible to obtain free fat acids under such conditions.

8. Have you read the article in the Chemical Gazette, vol. 14, p. 28? If aye, state whether the assertion is correct, which is contained
203 in the extract of said article referred to in the eighth interrogatory proposed to Dr. Genth, commencing with the words "I have also ascertained," and ending with the word "saponification."

I have read said article, and affirm from my own experiments that the assertion is false, basing my affirmation on the first experiment described in my answer to interrogatory second.

9. Have you made any experiment to prove whether the theory pro-

posed in said article is true, or false, as contained in the following extract from same work, to wit:

"In the new re-actions just mentioned we can understand that water, at a temperature of 302° to 320° Fahr., may decompose a neutral soap into an acid soap and a very basic soap, and that the latter acts secondarily upon a new quantity of fatty matter, in the same way as a free alkali."

I have made an experiment to determine the correctness of the theory, by heating neutral lime-soap with water at 350° Fahr., during six hours. I ascertained, by chemical examination, subsequently to the experiment, that the lime-soap was wholly unchanged, and still remained neutral lime-soap; and, therefore, the theory contained in the extract is false.

10. Please state whether or not the process of saponification with four per cent. of lime, described in the article in the Chemical Gazette, above alluded to, substantially resembles the process described by the defendant in his answer, as being used by him?

It is substantially the same; consisting of saponification of part of the fat by the four per cent. of lime, and the decomposition of the remainder of the fat into free fat acids and glycerine, by water at a high temperature.

11. State whether the process described in the Chemical Gazette bears any resemblance to the process patented to plaintiff; and if so, in what respect, and to what extent?

It resembles plaintiff's process, in a decomposition of a portion of the fat by water at high temperature and pressure.

12. Judging from your own experiments, taken in connection with your general scientific knowledge, please point out wherein plaintiff's process resembles or differs from the processes described in Payen, in Regnault, Roret's Encyclopædia, Dunn's patent, and in the defendant's answer, as to the conditions necessary, the results produced, and the action which takes place in those processes, respectively.

204 In Tilghman's process the conditions are—first, presence of fat to be acted on; second, presence of water, so highly heated as to require pressure to retain it in the liquid state; third, the total or partial absence of lime or other alkali, so that there is more fat present than the lime or alkali can possible combine with. The results are production of glycerine and of free fat acids. The action is, that water highly heated, as the above conditions require, separates fat into two bodies, which, at the moment of elimination, unite with some of the water, and forms free fat acids and glycerine.

In the processes in Payen and Regnault, the conditions are—first, the presence of fat heated to 572° Fahr., in an open vessel, under which conditions it is impossible for water to exist in a liquid state; second, a current of steam, superheated or not, to carry over fat acids into a condenser. The results are—first, the production of free fat acids; second, of acrolein and other products, arising from the destruction of glycerine; third, some tarry matter from the partial destruction of fat. The action is that the glycerine is destroyed in the act of distilling, and the remainder of the fat combines with steam to form free fat acids, which distill over into the condenser. These processes resembles Tilghman's only in the production of free fat acids; not in the necessary conditions, nor in the production of glycerine, nor in the mode of action.

In the processes described in Roret's Encyclopædia, and Dunn's patent, the conditions are—first, the presence of fat; second, the presence of water heated to 300° Fahr., or more, under the corresponding pressure; third, the presence of lime or other alkali sufficient to combine with all

the fat. The results are—the production of glycerine, production of a neutral lime or alkaline soap, and no free fat acid. The action is, that the lime or alkali combines with all the fat to form a neutral soap, and sets free glycerine, which is dissolved in the water. These processes differ from Tilghman's in having sufficient lime or alkali to combine with all the fat, in the production of neutral soap, and in their not producing free fat acids.

In the description of defendant's process, as given in his answer, the conditions are—first, the presence of fat; second, the presence of water heated to 350° Fahr., under corresponding pressure; third, the presence of lime in such proportion as can only combine with part of the fat, leaving the other part of the fat without any lime to combine with. The results are—first, the production of glycerine; second, the production of lime-soap in quantity corresponding to the lime present; third, the production of free fat acids in proportion to that portion of the fat which had no lime to combine with. The action is—first, that the lime combines with a part of the fat, forming neutral lime-soap, and freeing glycerine, which dissolves in water; second, that water acts on the other
205 part of the fat, uniting with it to form free fat acids, and setting free glycerine. The defendant's process resembles that in Roret's and Dunn's, in regard to the production of lime-soap, and resembles Tilghman's in regard to the production of free fat acid.

13. Have you recently made any chemical examination of an alleged sample of defendant's product? If yea, state from whom you received that sample; what treatment you subjected it to; what product you obtained from it; and deposit any sample of those products with the commissioner.

I have made an examination of a fatty substance, which I received from Mr. B. C. Tilghman, in August, 1860, which he alleged was the product of defendant's process. When treated with alcohol and other solvents, I obtained the free fat acids in solution, and the lime-soap undissolved. I produce and deposit such samples, marked No. 7, (C. F. H.)

14. You have stated, in your previous examination, that you had received from B. C. Tilghman an alleged sample of defendant's product, for analysis, please state whether you gave a portion of said sample to any person; and, if so, to whom?

I gave a portion of that sample to Dr. R. E. Rogers, professor in the University of Pennsylvnia.

15. If you have prepared any sample of tincture of litmus, suitable for testing free fat acids, please deposit it with the commissioner, and state what change is produced in said tincture, by the addition of an alcholic solution of free fat acids.

I have prepared a sample of tincture of litmus, which I now produce, marked No. 8, (C. F. H.,) suitable for the purpose mentioned. It is reddened by such addition.

16. From the result of your own experiments in the process of decomposing fats into free fat acids and glycerine, by the action of water alone, at high temperatures and pressures, is it your opinion, or not, that that process could be worked economically, as compared with the process as described by the defendant in his answer, as used by himself and others, prior to the date of plaintiff's patent?

It is decidedly my opinion that it can be worked economically in comparison with the other processes alluded to.

JA'S C. BOOTH.

206 UNITED STATES,
Eastern District of Pennsylvania:

I, Charles F. Heazlitt, a commissioner appointed by the circuit court of the United States in and for the eastern district of Pennsylvania, in the third circuit, under and by virtue of the acts of Congress, do hereby certify that the reason for taking the foregoing depositions, and the fact is, that the witnesses reside more than one hundred miles from the place where the trial of the said cause is to be held.

I further certify that a notification of the time and place of taking said deposition was made out and served upon Charles Fox, esquire, of counsel with said defendant, a copy of which notice, and proof of the service thereof, is hereto annexed.

I further certify that on the 27th, 28th, 29th, 30th, 31st days of August, and 1st, 3d, 4th September, A. D. 1860, I was attended by George Harding, esquire, of counsel with the said plaintiff, and by the witnesses, who were of sound mind and lawful age; and the witnesses having been by me carefully examined and cautioned and severally sworn to testify the whole truth, the depositions were by me reduced to writing in the presence of the witnesses, who subscribed the same in my presence; and I have retained the said depositions in my possession, for the purpose of transmitting the same, by mail, to the court for which the same was taken.

I further certify that I am not of counsel or attorney for either of the parties in the said depositions and caption named, or in any way interested in the event of the said cause.

In testimony whereof I have subscribed my name and affixed my seal this twenty-eighth day of September, A. D. 1860.

[SEAL.] CHA'S F. HEAZLITT,
U. S. Commissioner.

207 *Notice for taking depositions.*

Circuit court of the United States in and for the southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK.

The defendant will take notice that, on the 27th day of August, A. D. 1860, the plaintiff will take the depositions of sundry witnesses, to be used as evidence on his behalf at the trial of the above cause, at the office of Charles F. Heazlitt, No. 104 South Fifth street, in the city of Philadelphia and State of Pennsylvania, before competent authority, between the hours of eight o'clock a. m. and six o'clock p. m., of said day; and the taking of the same will be adjourned from day to day, between the same hours, until they are completed, if not all taken on the day noticed.

GEORGE HARDING, *Solicitor.*
Per C. B. TILGHMAN.

Service of above notice is acknowledged and proof of the official character of the officer taking the depositions is waived; also all exceptions as to time.

THE STATE OF OHIO,
County of Hamilton, City of Cincinnati, set:

Personally came before me, Thomas M. James, a notary public within and for the county and State aforesaid, duly commissioned and sworn, Walter F. Straub, who, upon being duly sworn, deposeth and saith: That he, said Straub, did, on this twenty-first day of August, A. D. 1860, at the request of Henry Stanbery, esq., of counsel for plaintiff in the case of Tilghman vs. Werk, now pending in the circuit court of the United States for the southern district of Ohio, serve a true copy of the notice in said cause, hereto attached, on Cha's Fox, esq., of counsel for defendant, by leaving same at his office, Main street, in the said city of Cincinnati. And further deponent saith not.

WALTER F. STRAUB.

Sworn to and subscribed before me and in my presence, the day and year above written.

Witness my hand and official seal, at Cincinnati aforesaid.

[SEAL.] T. M. JAMES,
Notary Public, Ham. Co., Ohio.

208 Seventh circuit court of the United States in and for the southern district of Ohio.

RICHARD A. TILGHMAN }
vs.
MICHAEL WERK. }

JULY 31, 1860.

On the hearing of this case, the defendants will offer in evidence the extracts from the following publications: 1st. The specification and patent and drawings contained in pages 205, 206, and 207 of the eleventh vol. of the second series of Repertory of Patent Inventions in January and June, 1839, published by J. S. Hodson, 112 Fleet street, London. Also, the passage from N. V. Regnault's Chemistry, English edition, published by Parrish, Demmieg & Mears, in Philadelphia, 1852, sections 1593, 1594, in pages 686 and 687 of the work. Also, the translation of the original French work of Regnault Payen, as translated by Professor Booth, attached to his deposition.

Also, the passage in Encyclopedie Roret, published in Paris in 1849, embraced in pages 113, 114, and 115. Also, the passage in the 318th No. of the Chemical Gazette, published in London on the 15th Jan'y, 1856, by Taylor & Francis, entitled "On the saponification of neutral and fatty bodies by soaps," by M. J. Pelouse, in pages 27, 28, and 29.

Also, the patent granted to defendant, dated 5th October, 1858.

CHARLES FOX,
For Defendant.

The complainant offers in evidence:

Letters-patent of R. A. Tilghman, dated October 3, 1854, marked A, (C. F. H.)

Certified copy of the correspondence and record of the Patent-Office on the application of M. Werk's patent of October 5, 1858, marked B, (C. F. H.)

209 TILGHMAN *vs.* WERK.

Depositions of witnesses on the part of defendant, taken before B. J. Horton, notary, pursuant to notice, at the office of Fox & Fox, Cincinnati, February 11, 1860.

E. GRASSELI sworn. Examined by Mr. Fox, defendant's attorney:

1. Question. Please state your business, and how long you have followed it, and where?

Answer. I am a chemist; have been so since my sixteenth year; about 34 years in France, Germany, and in this country; have been in Cincinnati about 22 years. I have been a chemist all that time.

2. Q. State how and in what manner you and other persons engaged in the same business with you have procured free fat acids and the solution of glycerine from fatty and oily substances. Please describe, as fully as you can, the means used for that purpose, the kind of tanks used for that purpose, and whether closed or open, and how you have applied the necessary heat. If you have at various times employed different means and apparatus, please describe them, and when those different modes were used.

A. This branch of manufacture, the manufacture of star candles, was commenced in France about 1830. They saponify about 100 lbs. of tallow by from 20 to 24 lbs. of quicklime. By this process the glycerine is separated from the fatty acids, the glycerine remaining in the water and the fatty acids forming a neutral soap with the lime. The neutral soap is then decomposed by the use of diluted sulphuric acid, until all the lime used is taken up or neutralized by the sulphuric acid, the residium of the operation being sulphate of lime, which leaves the fatty acids entirely free. They are then exposed to crystalization in a cool place or cellar, and then pressed cold in a hydraulic press. This is the first operation. By this first pressing the oleic acid is separated, and the stearic and margaric acids remain, and is then pressed in a hydraulic press at a temperature of 90° to 110° Fahrenheit. By this operation the last remains of oleic acid are separated, and the two acids, the stearic and the margaric acids, are then ready to run into candles, after being melted and treated a second time with a small quantity of diluted sulphuric acid.

For the saponification with lime, they might use wooden tubs—open wooden tubs; but for the decomposition of the neutral soaps, open wooden tubs, lined with lead, are necessary. Steam is applied during the whole process by being passed through the liquids. I have not myself used different means; but, as a chemist, I am acquainted with them.

Previous to 1855, a new process was discovered in France, to use less lime in the saponification of the fatty acids, by the use of superheated steam in close vessels. By this process an acid soap is obtained instead of a neutral one, and consequently a less quantity of sulphuric acid is used for the decomposition of this acid soap. By this means
210 the quantity of lime used has been reduced as low as 4 lbs. of lime to 100 lbs. of tallow.

There is a condensed statement of the means used for this purpose in Wagner's Yearly Report. Previous to that time, about 1845 or 1848, experiments had been made by using superheated steam alone to decompose fatty acids without the use of lime or any other alkali; the

glycerine uniting with the water and leaving the fatty acids free. But this process is slow and rather dangerous. The first process described here has been followed since 1850, by distillation in large copper stills by the use of superheated steam, the fatty substances having been previously treated with from 4 to 6 per cent. of concentrated sulphuric acid. This process is still in use. By superheated steam I mean a temperature of from 450° to 600° Fahrenheit, and above.

3. Q. How much sulphuric acid do you use to neutralize a pound of quicklime?

A. I don't remember; there is always an excess of acid used.

4. Q. Have you known that free fat acids and solution of glycerine can be produced by heat alone?

Yes; I have known it.

5. Q. If yea, how long since, and how have you ascertained this?

A. I don't remember now the works in which I have read it; but I have read it in Payen's C'emistry, edition of 1851, published in Paris, France. I first read of the process previous to 1850. I have not practiced this myself; but I know how it can be done. It is in practical operation in this country, in Philadelphia, England, and France.

6. Q. State your opinion, whether it is, practically and economically speaking, possible to produce free fat acids and solution of glycerine from fatty or oily substances by the application of heat and water alone, without the use of other chemical substances with the fatty substances. If yea, what degree of heat is necessary for that purpose?

A. In my opinion, this process cannot be used economically here in this country. It might be used in England, because labor and capital is cheaper. It would require about 600° of heat with water alone.

7. Q. Can you state the quantities of lime and sulphuric acid, with the use of superheated steam introduced into closed tank or vessel, necessary to produce free fat acids from 100 lbs. of fatty or oily substances? If yea, state; and what is the value or cost to the manufacturer of such sulphuric acid and lime?

State also the quantity of sulphuric acid necessary to produce the same result when the fatty or oily substance is heated in a close tank without the use of superheated steam.

211 A. It is my opinion that half the quantity of lime compared with that used formerly will be enough, by using superheated steam in close vessels, and consequently half the quantity of sulphuric acid is necessary, and the time of the operation is shortened by the use of superheated steam, and a better yield of fatty acid is obtained.

(Signed) E. GRASELLI.

E. GRASELLI, recalled, Feb. 23d, 1860.

Cross-examined by Tilghman for plaintiff:

8. Q. What is the date of the book containing the account of the process referred to in your answer to the second question wherein the fat is treated by 4 per cent. of lime in a close vessel?

A. It was Wagner's yearly report of the year 1855.

9. Q. Have you ever seen an account of that process in any book previous to that date?

A. No, sir.

10. Q. In speaking of an acid soap, do you not mean a combination of neutral soap, with an excess of fat acid?

A. It is not a combination of neutral soap, but an acid soap, altogether, in which fatty acids are in excess of the lime, which is used as a base.

(Signed) E. GRASELLI.

E. GRASELLI, re-examined by defendant's attorney:

11. Q. Please state what difference there is, if any, between the process of Mr. Tilghman, and the process used by Mr. Werk, suppose the latter uses 7 lbs. of lime to 100 lbs. of fatty substance?

A. As far as I am acquainted with the process of Mr. Tilghman, his process consists in passing an emulsion of fats and water through a series of pipes, heated at a high temperature.

By this process the glycerine is separated from the fatty matters, and the fatty acids are left free. It might then be used for the manufacture of candles.

As far as I am acquainted with the process used by Mr. Werk, he uses a less quantity of lime than was used in the old process of forming a neutral soap. By using a less quantity of lime and subjecting the fatty matters, in presence of the lime and water, to a current of superheated steam, a neutral soap is first obtained, which, by the help of the superheated steam, or increase of heat has the tendency to free the balance of the fats used of their glycerine, and thus changing
212 the whole compound to an acid soap, in which the fat acids are in excess. The smallest quantity of lime which has been found to answer this purpose is not less than 4 per cent. of the fatty matter. To free this acid soap from its base, the lime, sulphuric acid is used, but in less quantity than would have been necessary to decompose the neutral soap; while in the process of Mr. Tilghman there is no lime, and consequently no acid used at all.

12. Q. What do you call the product of fatty substances when the glycerine is separated by means of lime, and the lime separated by sulphuric acid?

A. In the first place, I call it an acid soap, so long as the lime is with it, and after the lime is eliminated by sulphuric acid, it is free fat acid.

13. Q. Please state what you call the product of fatty substances by the action of water at a high temperature and pressure.

A. Free fat acids and glycerine.

(Signed) E. GRASELLI.

EDWARD S. WAYNE sworn. Examined by defendant's attorney:

1. Q. Please state your business, how long you have followed it, and where?

A. I am a chemist by profession; have been engaged in it, practically and scientifically, for the last 15 years, in Cincinnati, and also in Philadelphia previously.

2. Q. Please state your knowledge of the mode and manner of producing free fat acids, and the solution of glycerine from fatty or oily substances. Describe the usual mode in which this is done, whether by heat alone, or by the use of heat with chemical substances, mixed with the fatty or oily substances?

A. I am theoretically acquainted with the manufacturing of stearic acid and glycerine. There is one process by saponification, by means of lime, which forms a fatty soap with the lime, and free glycerine separated by the decomposition is held in solution in the water present. To this lime-soap sulphuric acid is added, which decomposes it, forming sulphate of lime with the lime, and sets the fatty acids free. Another process, sulphuric acid itself is used as a saponifer; the acid combines with the glycerine, and the fat acids are liberated. The fat acids after this treatment are washed with water to free them from the acid as much as possible, then they are placed in a copper still, and distilled over by means of a current of superheated steam. Sometimes,

213 also, an auxiliary fire is placed under the bottom of the still; this is not universal. By this process the glycerine is lost, and thrown away in combination with the sulphuric acid as a waste product. Stearic acid distils over from the still, but not as pure stearic acid; it contains beside stearic acid, solid hydrocarbons, mutual products of the decomposition of stearic and oleic acids by the action of heat; also accompanied with more or less acrolein.

By that process a larger quantity of candle-stock can, I believe, be obtained than by the former one, but I question its economy over the other process mentioned above, from the fact that the oleic acid obtained has much less market-value than the other.

Another process that I am acquainted with is the reducing the quantity of lime mentioned in the first instance, say, down to one-fourth, (say from 15 to 20 lbs. of lime to 100 lbs. of fat, are used in the first process,) placing the lime and fat in a suitable close vessel, and applying either superheated steam or pressure, producing thereby an acid soap.

Stearic acid is a tribasic body, that is, will combine with one, two, or three equivalents of a base. By a base, I mean lime, potash, soda, and hydrogen. Now this acid soap is a stearic soap, containing one equivalent of lime, say, and two equivalents of hydrogen, obtained by the decomposition of water in this process. This acid lime-soap, consequently requires only one-third the quantity of acid, to decompose it into fatty acids, than would be required to be used in the first process mentioned, consequently it is more economical.

I am also acquainted with another process by the use of superheated steam alone—two other processes: The first that of Messrs. Tilghman, by passing a mixture of oil and water through a coil of pipe heated to a temperature between 600° and 700° Fahr. of heat. Decomposition ensues by the process, and free fatty acids and glycerine are obtained.

In this process the elements of water, oxygen, and hydrogen are the elements of the decomposition, being held in a very slight union at the temperature to which they are submitted, the hydrogen acting as a base, as it were, for the acids.

I am also acquainted with a process somewhat in its principles parallel, but practically different, by merely transmitting a current of superheated steam into a still, containing the neutral fatty bodies, causing free fatty acids and free glycerine to distil over.

In both these processes the glycerine is carried over mechanically, by the steam acting as a carrier, as glycerine will not distil, per se, without decomposition.

I am also acquainted with another process, in which an alkali,
214 potash, is used as a saponifier. To this soap alumina, in the form of clay, or otherwise, is added, which decomposes the potash-soap, the fatty acids combining with the alumina, the potash being set free. This alumina-soap is decomposed by means of sulphuric acid, the waste product thus being made a source of profit, being thus converted into a double sulphate of alumina and potash, commercially known as alum.

Another process is saponification by means of chloride of zinc, acting chemically upon the neutral fats, decomposing them into fatty acids and glycerine. This process may be economical, as nearly the whole of the chloride of zinc used may be obtained back again. The decomposing power of chloride of zinc illustrates the action exercised by superheated steam on fatty bodies, namely, the decomposition of water, and the fix'tion of *of* the oxygen and hydrogen liberated between

the fatty acids and the glycerine. This last process has been used in South America for forming fatty acids there.

3. Q. Have you known that free fat acids and solution of glycerine can be produced by heat and water alone? If yea, how long since, and how have you ascertained this? If from scientific works, state the names of the works and publications when made, and where published. If you have practical knowledge, *and* state when and where.

A. I have known free fat acids and glycerine to be obtained by the fixation of the elements of water, through the agency of steam and heat. This decomposition is mentioned by Payen, published in Paris, in 1851. I have had access to a copy since the fall of 1851, or spring of 1852. My copy is a German copy. It is also stated in Regnault's Chemistry. My copy is an American edition; don't recollect the date; published in Philadelphia by Lippincott & Co,, I think, 8 or 9 years ago. I may safely say that I have known it as a general chemical fact for the last 9 or 10 years. I have never practically manufactured stearic acid, or been engaged in the business, but I have been frequently consulted on the subject by manufacturers. From the description contained in those works, coupled with my general knowledge of chemistry, I could carry out the process of decomposition by steam and heat.

4. Q. State your opinion whether it is, practically and economically speaking, possible to produce free fat acids and solution of glycerine from fatty or oily substances, by the application of heat and water alone, without the use of other chemical substances, with the fatty substances. If yea, what degree of heat is necessary for that purpose?

A. I believe that it is, but I do not think the process of Mr. Tilghman's is the practical process, economically considered. The wear and tear of apparatus would increase the cost of production too much; by wear and tear I mean the destruction of the pipes, and the small quantity that could be operated upon in a given time. Experimentally it is a very perfect process, so far as the theory involved in the process is concerned.

215 A distillation of that kind can be produced by a heat of 550° to 650° Far.

I believe steam and heat are used alone in decomposing neutral fat bodies, at present, by Price & Co., of London, ther'by producing glycerine and fat acids.

5. Q. Can you state the quantities of lime and sulphuric acid, with the use of superheated steam, introduced into a closed tank or vessel, necessary to produce free fat acids from 100 pounds of fatty or oily substances? If yea, state; and what is the value or cost to the manufacturer of such sulphuric acid and lime. State also the quantity of sulphuric acid necessary to produce the same result, when the fatty or oily substance is heated in a close tank without the use of superheated steam.

A. The quantity of lime used where superheated steam is used in close vessels with water is 5 lbs. lime to 100 lbs. of fat.

The same quantity of lime is necessary, also, where heat alone is used with water. The principle involved in both is the same. By means of pressure you increase the boiling-point of water, and, consequently, you obtain the desired temperature. Temperature alone is necessary. By the use of superheated steam you obtain the same end in close vessels. I allude there to close vessels. The quantity of sulphuric acid required is of course reduced. For instance, if 15 lbs. of lime were used by the old process, it would probably require about 35 lbs. of ordinary sulphuric acid to decompose the lime-soap. By reducing the lime to, say

5 lbs., from 11 to 12 lbs. of acid would be required. It takes a little over 2 lbs. of acid to 1 lb. of lime.

6. Q. You have alluded to Mr. Tilghman's mode or method of producing free fatty acids by heat. Please state what other modes can be resorted to in order to produce the same result.

Is it necessary to have a heavy pressure in order to prevent the conversion of the water into steam during the process?

A. (No, sir; the pressure is not absolutely necessary to prevent the conversion of the water into steam. Steam being thrown in in a superheated state, a portion of it decomposing and acting chemically would split the fatty bodies into fat acids and glycerine. The excess of steam escaping from the still would carry over the glycerine mechanically, and also facilitate the distillation over of the stearic acid.) This portion in parenthesis noticed in cross-examination.

7. Q. To prevent the conversion of the water into steam is it necessery to have pressure?

A. I can heat water red-hot if I can confine it long enough; and again, I can throw water upon red-hot iron, which will evaporate very slowly from the heated surface, it assuming what is well known as the spheroidal condition, the philosophy of which it is not necessary to explain.

216 8. Q. Please state whether you have examined the specification of Mr. Tilghman's patent. If yea, state how he produce' a pressure to prevent the water being converted into steam. State, also, whether the same degree of heat can be obtained without adopting that mode of pressure.

A. The plan Mr. Tilghman adopts is by means of a loaded safety-valve; the same degree of heat could be obtained otherwise.

E. S. WAYNE re-called February 23d.

Cross-examined by B. C. Tilghman, for plaintiff:

9. Q. You have stated, in your answer to the second question, that you are acquainted with a process for manufacturing fat acids, wherein, instead of 15 or 20 per cent. of lime, only one-fourth that proportion is used, by placing the lime and fat in a close vessel and applying either superheated steam or pressure, producing thereby an acid lime-soap. When did you first know of this process?

A. I think about 1855 was the first I remember of it. I have seen it in Wagner, (but my impression is that Mr. Graselli told me of it some years before, on his return from Paris.)

(The part of above answer in parenthesis objected to as hearsay.)

10. Q. Are not fat acids, whether produced by one of the processes mentioned in answer to the second question in chief, or any other of said processes, chemically the same substances?

A. Yes.

11. Q. You have said that fat acids are tribasic, and that, in the case of the acid lime-soap, it combines with one equivalent of lime and two equivalents of hydrogen. Now, suppose the lime was absent, would not the fat acid be then combined with another equivalent of hydrogen?

A. If there was no lime present, unquestionably.

12. Q. When fat acid is combined with no other base than hydrogen, is it not the same as what chemists call free fat acids?

A. Yes, sir.

13. Q. Is not this hydrogen necessary to its existence as free fat acid?

A. Yes, sir.

14. Q. Do not all acids, such as common sulphuric, nitric, and muriatic acids, contain a certain amount of water, or hydrogen, or other substance, which is theoretically considered as a base?

A. Yes, sir.

217 15. Q. By the term acid soap do you not mean a compound, in which lime is combined with an excess of fat acid?

A. No; it contains hydrogen as a base, which may be replaced by other bases, such as lime or water. For instance, sulphuric acid acts as a bibasic acid in many cases. It will combine with one equivalent of base and one equivalent of water, making a bibasic compound; so, also, phosphoric acid will form a tribasic salt or compound with water and bases.

16. Q. Do you consider what is vulgarly and commonly called free fat acids to be combined with a base, in the sense of your last answer?

A. Yes.

17. Q. In the process you have spoken of, as mentioned in Wagner, what becomes of the glycerine; is it destroyed or dissolved in water?

A. Dissolved in water.

18. Q. In that process, is water in a liquid state necessary to be present in the close vessel along with the lime and fat, in order to dissolve the glycerine?

A. Water is necessary in that process.

19. Q. What temperature do you understand to be used in that process?

A. 400° to 450° Fahr.

20. Q. If that temperature is used and water is present is it not necessary that the vessel should be closed so as to prevent the water escaping as steam?

A. Under certain conditions it would be. Now there is a very great difference in the application. In the saponification of fatty bodies by means of a small percentage of lime a certain amount of heat is necessary to produce the decomposition. This heat may be thrown in in a superheated condition; steam is commonly used. This heat coming in immediate contact will produce the decomposition with much less pressure on a safety-valve than the temperature necessary to raise the heat of steam to the point mentioned, 400° to 450°. In case superheated steam is not used the safety-valve of the vessel would have to be loaded to a greater extent than in the other to obtain the necessary heat. I would further remark, it would make no difference how the heat is applied, having water or steam present.

21. Q. In a common steam-boiler are not the water and the steam at the same temperature?

A. Sensibly, but not actually; by a thermometer they are.

22. Q. Is not superheated steam steam which has received an extra dose of heat out of the presence of water?

218 A. Steam is the same as a gas, and viewed as such. We call it a gaseous body. It absorbs heat and expands by heat the same as any other gaseous body. The laws of expansion are the same. Steam may be superheated in the presence of water. Superheated steam is a current of steam heated to an indefinite point by passing through heated coils or pipes.

23. Q. If superheated steam, commonly so called, be injected into water at 212° Fahr., what effect is produced?

A. It would cause evaporation of it, unless confined by pressure.

24. Q. If the vessel containing the water be closed, will not the pressure therein be increased in an exact ratio to the amount of heat imparted to the water by the superheated steam?

A. No, sir; that is to be explained. If I pass steam of a low tension or a high tension, either one, from a boiler, through a superheater, into another vessel partially filled with water and also closed, the latter will become heated until the temperature is somewhat superior to that of the boiler supplying the steam. The temperature will then be equalized, the temperature and the pressure both.

25. Q. In the process above mentioned, with 4 per cent. of lime, is there any distillation of the fat acid?

A. None.

26. Q. In the process referred to in Regnault, where the fat is distilled at a temperature of 570° Fahr. and the saponification obtained by heat alone, is there any water present in the still in a liquid state?

A. No, sir.

27. Q. Is any pressure employed in that process?

A. The pressure is not necessary.

28. Q. Is the glycerine destroyed in that process?

A. More or less; not entirely.

29. Q. In Tilghman's process is any water present with the fat, in a liquid state?

A. Water is present, with the pressure used.

30. Q. Is the glycerine destroyed or dissolved in the water?

A. The glycerine is not destroyed, it is dissolved in the water.

31. Q. Is the fat acid distilled in Tilghman's process?

A. No, sir.

219 32. Q. In your answer to the sixth question-in-chief, in that part of the answer enclosed in parenthesis, do you refer to Tilghman's process?

A. No, sir.

33. Q. Referring to your answer to the fourth question-in-chief, setting aside the question of economy, could you, from your skill as a practical chemist, produce free fat acids and solution of glycerine, by the process and in the apparatus described in Tilghman's patent?

A. Yes, sir; I could work it.

34. Q. Is it your opinion, as a practical chemist, that you could economically produce free fat acids and solution of glycerine, in any other form of apparatus, but by the same process as that described in Tilghman's patent, to wit, the action of water upon fats, at a high temperature and pressure?

A. I do not think the apparatus could be modified so as to produce fat acids with economy, in an apparatus differing in the tube-form of Messrs. Tilghman's; that the actual contact of the elements could not be brought into such intimate chemical contact by any other form of apparatus, but fat acids could be produced in vessels of another form, but would require probably much longer time to produce decomposition.

(Signed) E. WAYNE.

E. S. WAYNE, cross-examination continued by B. C. Tilghman, February 25:

35. Q. You have stated that the product of the process with water and four per cent. of lime in a close vessel with pressure, would be an acid soap. Now, if 6 to 7 per cent. of lime were used, under the same circumstances, what would be the product?

A. It would still be an acid soap. I call all soaps, lime-soaps, acid soaps, that do not contain sufficient base to saturate the three equivalents of stearic acid.

36. Q. So far as the economy of the manufacture in the consumption

of sulphuric acid is concerned, is not the excess of fat acid in this acid soap as profitable to the manufacture as if it were what is commonly called free fat acids?

A. The acid soap is more economical than the neutral soap, as requiring less acid.

37. Q. Can you point out, in any book published prior to January 9, 1854, an account of any process whereby fats have been converted into fat acids, and the solution of glycerine by the action of water in a liquid state at a high temperature and pressure?

220 A. I have not seen, prior to that time, a published process or apparatus for accomplishing this same, but the hypothesis I have seen prior, that is, published prior to that time.

38. Q. Can you point out in any book published prior to January 9, 1854, an account of any process whereby fats have been saponified in close vessels containing water at high temperatures and pressures, by means of a quantity of lime less than the chemical equivalent so as to produce an acid soap?

A. Yes, I have; prior to January 9, 1854. It is either in Payen or Wagner, I can't say which. I heard of the process before I saw it published.

(The latter part objected to by plaintiff as hearsay.)

39. Q. At this time can you specify the book, volume, and page where you saw this process?

A. No; I can not.

By defendant's attorney:

40. Q. Will you please define what is meant by free fat acids?

A. I mean by free fat acid an acid fat containing merely the elements of carbon, hydrogen, and oxygen, uncombined with any metallic base.

41. Q. In fatty substances used for making candles, please state what per cent. glycerine is obtained.

A. The fat bodies do not contain glycerine, per se, but by the decomposition of fatty bodies into fat acids about 10 per cent. of glycerine is obtained.

42. Q. In what way can that glycerine be separated by chemicals? Can it be separated by heat and water alone, so as to produce free fat acid? If yea, at what degree of heat?

A. Glycerine can be separated at a low temperature by means of mineral bodies, particularly the oxides of the alkaline minerals, say, lime, potash, and soda; about 14 per cent. of lime. Free fat acid and glycerine can also be obtained by the use of a smaller quantity of lime than the one mentioned, but as a general thing as the quantity of alkali is reduced, an elevation of temperature is more or less necessary to produce decomposition, forming a lime-soap, containing less base than the former, and glycerine. Fat bodies can also be decomposed into fat acids and glycerine by the action of water, or steam at a high temperature. Water or steam at a high temperature, say 600° to 650° Fa'r., the elements hydrogen and oxygen, apparently having their affinity

221 very much weakened by the temperature, act as it were merely as a mechanical mixture of the gases in a nascent state, which combines with the fat bodies, free fat acids and glycerine being the result.

43. Q. How long has it been known to chemists that free fat acids can be procured by water and heat alone, as above described?

A. The fact has been known theoretically, I think, for this last ten years—eight years to my certain knowledge—eight years since 1852. I

think the first practical operation of that kind was that of the Messrs. Tilghman. I have never seen Tilghman's apparatus in practice. I think the first explanation and drawings of the apparatus and description of the process was in the London Pharmaceutical Journal in 1855; afterwards I saw it in the Patent-Office Reports of same year.

44. Q. Suppose the inside of the boiler or tank, in which the grease is contained, is heated to 650° Fa'r., what would be the pressure?

A. I should think the pressure would be about 400 lbs. to the inch.

45. Q. What is the difference between acid soap and free fat acid?

A. An acid soap is a fat acid containing 1 or 2 equivalents of a mineral base, such as lime, potash, &c. Fatty acids are tribasic, that is, stearic-acid will combine 3 equivalents of a mineral base, forming a neutral soap. If one equivalent of a mineral base be taken from it, and be replaced with either hydrogen or water, an acid soap will be the result.

46. Q. Can you obtain a free fat acid while lime is present?

A. No, sir; not entirely. There would be a soap formed to the extent of the lime present. The mass would contain an acid lime-soap, with free fat acids.

47. Q. Please state what you call the product produced by heat, water, and fatty substances, at a high degree of temperature, say 612° Fa'r.?

A. I call them free fat acids and glycerine.

50. Q. What do you call the product of fatty substances, when the glycerine is separated by means of lime, and the lime separated by sulphuric acid?

A. If 14 or 15 lbs. of lime is used, the product would be a neutral lime-soap. This neutral lime-soap, by being decomposed with sulphuric acid, would give free fat acid and sulphate of lime.

51. Q. Can an acid soap be converted into free fat acids without using another acid, and is there any free fat acid present in an acid soap?

222 A. An acid soap cannot be converted into free fat acid without the use of another acid, having a greater affinity for the base than the fat acid. There is no free fat acid present in an acid soap. In an acid soap, water or hydrogen acts as a base.

52. Q. Please state what you call the product of fatty substances, by the action of water at a high temperature and pressure.

A. Free fat acids.

53. Q. At what degree of heat is water decomposed into its simple elements?

A. I know of no degree of heat at which water is decomposed into its simple elements; but water at a high temperature acts differently in chemical decompositions and combinations. Its elements seem to act with greater freedom, and as elements in a nascent state. Water is decomposed by passing it in a state of vapor over heated metals, particularly iron, the iron absorbing its oxygen to a certain extent, and liberating hydrogen.

54. Q. What difference is there, if any, in the chemical results, between the process of Mr. Tilghman and the process used by Mr. Werk, suppose the latter uses 7 lbs. of lime to 100 lbs. of fatty substance?

A. By Tilghman's process, I consider the following to be the result: stearic acid, in its simplest form as monostearine, is composed of 35 equivalents of carbon, and 34 of hydrogen, 3 equivalents of oxygen, with 3 equivalents of water. This body, in its combination, acts as a triple combination, that is, three times the number of carbon, hydrogen, and oxygen mentioned, as monostearine is always present in a lime-

soap, combined with 3 equivalents of lime. In an acid soap one of these equivalents of lime, or two of them, may be replaced by water, acting as a base. In Messrs. Tilghman's process a neutral fat acid is produced, i. e., all the three equivalents of acid in combination with water, as follows: 3, C 35; H 34; O 3 + 3 H O. If seven pounds of lime are used in the production of fat acids, a different product would be obtained, namely, stearic acid in its triple form, but with this difference—two equivalents of water would be replaced by lime, as follows: 3, C 35; H 34; O 3 + H O 2 Ca. O.

(Signed) E. S. WAYNE.

223 ANDREW SPIES sworn.

Examined by defendant's attorney:

1. Question. Please state in whose employ you are, and how long you have been so engaged, and in what capacity.

Answer. I work for Mr. Werk, the defendant. I have been in his employ over 16 years at his factory in Cincinnati. I have cooked his stearine all this time.

2. Q. State how you have cooked the stearine at Mr. Werk's for the last two years.

A. I cook them in a tank, with lime and water; 5 to 6 or 7 lbs. of lime to 100 lbs. fat; generally use 7 lbs.—that is best—about 5,000 lbs. water to 7,000 lbs. fat; that is what the tank holds. The steam is conducted from the boiler, through pipes into the bottom of the tank, and the steam-pipes through which the steam passes are heated so as to increase the heat of the steam before it gets into the tank. The steam in the tank is heated from 336° to 350° Far., as measured by the thermometer. We do not use a pressure-*guage* at the boiler now. We did use it. We have a pressure in the steam-boiler from 110 to 120 lbs., as indicated by a steam-*guage* at the boiler. The steam escapes from a pipe from the top of the tank going up to the third story. The pressure in the tank is about the same as in the boiler. If the pressure of steam was greater in the tank than in the boiler the contents of the tank would run back into the boiler. There is a safety-valve at the boiler, and also one at the tank.

3. Q. Please state how much lime you used in procuring fat acids in Mr. Werk's manufactory prior to using the superheated steam.

A. Before using the tank in cooking I used from 11 to 14 lbs. lime to every 100 lbs. fat. I found 14 lbs. to do best. We used then open tubs, and put boards on the tubs; did not put weights on the boards.

4. Q. State whether you have tried the effect of using less than 5 lbs. of to 100 lbs. of fatty substance, at the manufactory of Mr. Werk, with the use of superheated steam. If yea, what was the result of using less than 5 lbs?

A. I have tried to cook with less than 5 lbs. of lime to 100 fat, and it is not good, and I have tried with 5 lbs. and it is not so good as with 6, and I have tried it with 6, and it was not so good as with 7, and 7 lbs. is the best.

(Signed) ANDREW SPIES.

NATHANIEL ROPES, Jr., sworn.

Examined by defendant's attorney:

1. Question. Please state your business, and how long you have followed it and where.

224 Answer. I have been manufacturing star candles in Cincinnati for 4 or 5 years.

2. Q. Please state in what way you separated the glycerine from the fatty substances used in the manufacturing star candles; that is, how much lime have you been in the habit of using in the process, and how much acid in afterwards separating the lime from the fatty substances?

A. We have used a tub about 10 feet diameter and about 8 feet high, with an iron steam-pipe at the bottom, through which the steam is conveyed; one main pipe in the middle, with from 6 to 8 cross-pipes. They are perforated with small holes. Into this tub we put stearine, using from 11 to 13 per cent. of lime, according to the quality of the stearine. The lime we make into a mixture called milk of lime, by adding water to it. After this milk of lime is thrown into a tub, and the cover is weighted, the whole mass is cooked for 6 or 8 hours. This is called a lime-soap. This lime-soap is then thrown into another tub, with a mixture of sulphuric acid and water. There it is cooked until it is thoroughly dissolved. This solution of grease is a combination of stearic, margaric, and oelic acids, which are separated from each other by means of hydraulic presses. After the lime-soap is formed, the glycerine combining with the water is run off. The rule is to use 2 lbs. of sulphuric acid to 1 lb. of lime.

3. Q. Please state whether you have been lately using a new process of effecting a separation of glycerine from the fatty substances. If yea, describe the process and machinery used.

A. We have recently been using a new process, introduced by Mr. Tilghman, of Philadelphia, by which he places 2,000 lbs. of stearine in a copper boiler, in which there is a stirrer or agitator, and mixes with it 1,000 lbs. of water, at a pressure of 150 lbs. to 155 lbs., and from 16 to 18 hours of cooking, the stearine is separated from its glycerine, and by this means became fat acids. This was placed in the hydraulic presses, similar to the old mode, and the stearic acid separated from the margaric and oelic acids. The boiler is set in a furnace and heated by a fire. This is owing to our boiler not having capacity to carry pressure over 90 lbs.

4. Q. State how long you have been operating in that way. State how many different experiments you have been trying to separate glycerine from fatty substances. Have you at any time used any steam into your copper boiler or tank? If yea, what heat is the steam introduced into the copper boiler?

A. We did this twice, first about five weeks ago, that is two heatings. I can't give the exact number of experiments. Since the former mode, we have been working with the usual regularity, varying from ½ per cent. to 2 per cent. of lime; generally, two batches in succession
225 of each percentage; that is, when we used ½ per cent. of lime, we made two batches of ½ per cent.; when we used 1 per cent. we made two batches of 1 per cent. When we first start in the mornings, we raise the pressure of the tank to the same pressure as our steam-boilers, by means of a pipe connecting the two together. After the tank has been raised to this pressure the steam from the large boiler is cut off by means of a stop-cock, and then heat up the tank as before to 150 lbs. by means of the fire.

5. Q. Please state why you ceased to operate without the introduction of any lime into your stearine or fatty substance. State also how much lime you now use when you produce the best results.

A. Owing to the length of time it took to separate the stearine into

glycerine and fat acids; this is the reason why we quit attempting to cook without using lime. As far as I am personally concerned, I was better pleased with the results of 2 per cent. of lime than any other, up to the 20th of this present month, in which we introduced more water and ½ per cent. of lime, the fat acids of which we have not yet pressed; but from the general appearance of the stock, I think the result will be the best.

6. Q. How many batches did you make with the ½ per cent. of lime, on the 20th instant? How much water did you use to a given weight of steam? How long did it take you to make the batch?

A. We made one batch on the 20th, and one on the 21st. We used 1,500 lbs. stearine and 1,500 lbs. water, and ½ per cent. lime. I suppose it was cooking from six to eight hours from the time the pressure was up.

7. Q. How long were you in getting the pressure up?

A. I don't know.

8. Q. How long did it take you to work the two first batches you speak of, without using any lime? State as nearly as you can.

A. The first batch was 18 hours; the second batch 16 to 16½ hours in cooking.

9. Q. How long did it take you to cook a batch in the old mode, before you began to operate under Mr. Tilghman's plan?

A. The first operation would be from six to seven hours. The next operation would be from four to five hours. To separate the glycerine would take from six to seven hours. Then to get the lime out would take from three to five hours.

10. Q. Please state how the free fat acids, which you say was produced in the two first batches without the use of lime, compared in purity and usefulness to that procured in the old process, by the use of lime.

226 A. In these two batches the glycerine was blown, together with the fat acids, into one tub, and there boiled up together to settle. Owing to this glycerine being mixed up through the grease, I do not think it would be right to say that the stearic acid obtained from these fat acids was not of as good a quality as that we have since obtained, as I think the glycerine somewhat darkened the stearic acid, the texture of which was solid and firm. The quality I should say was good, but the glycerine darkened the color. I don't think the free fat acids were as good as the fat acids we made under the old process, owing to the glycerine being boiled up with the fat acids, and thus darkening the color.

11. Q. Is it not important to the manufacturers of star candles that the fat acids should be of a pure white color?

A. As a general thing the fat acids, after decomposition, are of a yellow color.

12. Q. What color was the fat acids produced by the two batches made without lime? Was it near enough to the yellow color you speak of to be considered a good useful article?

A. I should say that the color of the fat acids produced by the two batches made without lime was actually lighter, but the stearic acid produced from this was somewhat darker, and from these two trials was not as good as that made under the old process.

13. Q. Please state under whose directions was your apparatus got up and at whose expense placed in your factory? Had Mr. Tilghman anything to do with the apparatus or conducting the process?

A. I can't say who got the apparatus up, or at whose expense it was

got up. It was placed in our factory by Mr. Tilghman, the brother and agent of the plaintiff, and at his expense, if we are not satisfied with his process sufficiently well to purchase it; that is, if I understand the agreement. I think that is the agreement.

14. Q. Have you and your partners yet become satisfied that Mr. Tilghman's process of separating the glycerine from fatty substances without the use of any lime, can be profitably used by manufacturers? Do you now manufacture under his process solely, or are you only experimenting on the matter?

A. We have not yet become satisfied that Mr. Tilghman's process of separating the glycerine from the fatty substances without the use of any lime can be profitably used by manufacturers. We are manufacturing daily with this tank, using from one-half to two per cent. of lime. I refuse to answer whether we are working solely in this way, because I think it is prying into my private business.

227 15. Q. Please state what degree of heat you use in the copper boiler or tank. How does the copper boiler lay or stand?

A. I don't know the degree of heat used in the tank. We use a steam-gauge, which indicates a pressure of 150 lbs. per square inch. The copper boiler stands horizontal, set in the furnace.

(Signed) N. ROPES, JR.

N. ROPES, Jr., re-examined by defendant's attorney, Feb. 25:

16. Question. Please state whether, in the process used under the direction of Mr. Tilghman, you use any acid. If so, state the quantity you use.

Answer. We use acid to decompose the stock, in the same proportion of acid to the percentage of lime as used in the old process.

Cross-examined by Mr. Tilghman, for plaintiff:

17. Question. Have you been making merchantable candles from the products of Mr. Tilghman's apparatus?

Answer. We have.

18. Q. In the old process is there not a waste of the fat, from some of the fat acid getting intimately mixed with the large quantity of sulphate of lime produced, and being thrown out with it?

A. There is a certain percentage of the fat lost in that way.

19. Q. Is not this waste less in Tilghman's process, on account of the less quantity of lime used, and of sulphate of lime produced?

A. I should suppose it was, but I should not like to say so for a certainty. I presume it from there being less lime used.

20. Q. By the old process, with 13 or 14 lbs. of lime and 100 lbs. of fat, how much fat acids were produced?

A. I have always thought 95 lbs. of fat acid from 100 lbs. of grease, or about five per cent. of waste on the original quantity of fat.

21. Q. By Tilghman's process, with ½ pound of lime and 100 pounds of fat, how much fat acid was produced?

A. According to weight of my own weighing, about 97 per cent. of the original weight of the fat.

228 22. Q. (By defendant's attorney.) What causes the loss of weight in the two processes? Is it not the separation of the glycerine from the grease, and does not the whole loss depend upon the amount of glycerine separated from the fatty substance?

A. According to the best authorities there is eight per cent., or eight and a fraction, of glycerine in the fat or grease that is used, but practically, by the use of lime, all the glycerine is not extracted from the fat.

When we come to decompose this lime-soap by the use of acid, we do not entirely extract the grease from the lime. There is always a percentage left in it, which can be obtained by working it separately. This percentage is so small that it would not justify doing so.

23. Q. If there is eight per cent. of glycerine in fatty substances, and you lose only three per cent. in weight in working by Mr. Tilghman's process, as I understand you, there is five per cent., or five per cent. and a fraction, of glycerine which is not separated from the fatty substances. Do I understand you correctly?

A. Well, I suppose that the glycerine is extracted, and the weight must be obtained from the water, as the theory has always been that fatty substances could not be crystalized until the glycerine was separated from it, or the greater part of the glycerine.

24. Q. Do you mean to say that the whole of the eight per cent. of the glycerine is in fact separated from the grease by Mr. Tilghman's process, and that the difference in the weight between 92 per cent. and 97 per cent. is made by a mixture of water with the grease?

A. I don't suppose that all the glycerine is extracted from the grease. What part of it is extracted, I don't know. I have never calculated or attempted to. As to the 97 parts of grease, I can account for it in no other way except it must be from the water and the half per cent. of lime that we used.

25. Q. If your fat acids contain glycerine at all, are they fit to use in making candles? If yea, with what amount of glycerine in the acids can you use these acids?

A. Well, I will have to say that I don't know, but I have always supposed that there was some glycerine in the fat acids, as one day's operations varies from the preceding day's.

(Signed) N. ROPES, JR.

229 C. H. GRANT sworn.

Examined by Mr. Werk, defendant, March 7, 1860:

1. Question. What is your business, where have you been following it, and how long?

Answer. My business is the manufacturing adamantine candles. I have followed it in the city of Philadelphia for about 9 years.

2. Q. Please state in what way you have separated the glycerine from the fatty substances used in the manufacture of stearic-acid candles.

A. We did that by saponification in open tubs, with 12 to 14 per cent. of lime. That was our first process. We then employed the process of acidifying, that is, pouring the oil of vitriol to the fat heated up to a high point, afterwards completing the process by distillation. This was the second process. Subsequently we used a third process, by the use of a close copper tank, with water, under a pressure of 150 lbs. to the square inch, or thereabouts. Sometimes without any lime, sometimes with ½ per cent. of lime, sometimes with about 1 per cent. of lime, and sometimes with about 2 per cent. of lime.

3. Q. What is the result by using water and heat alone?

A. The result is a decomposition of the fat into glycerine and fat acids, which were not as thorough and perfect, in our opinion, as with the use of lime.

4. Q. Could you compete with other manufacturers, by obtaining free fat acids by the agency of water and heat alone?

A. As far as our experiments have gone, I don't think we could. If we were to attempt it, we would want to experiment with a larger pro-

portion of water, or to repeat the process by drawing out the glycerine water and recharging with fresh water.

5. Q. What do you call the process for the manufacture of free fat acids by the use of fat, water, and heat alone; and whose is it, and how long have you been experimenting with that process?

A. We have called it the Tilghman process, and we have been experimenting with it, working with it, seven or eight months. I purchased the process from Mr. Tilghman, the plaintiff in this suit.

6. Q. After having obtained the free fat acids by heat and water, do you submit them to distillation in order to obtain a pure white stearic acid by the usual mode of pressing?

A. We have worked it by distillation, and by mixing the product of the copper boiler with other stock that had been distilled. I am not positively certain that we have ever mixed the product of the copper boiler that had been decomposed by water alone, without lime, but we have frequently mixed the stock that had been decomposed with the use of half per cent. of lime, and obtained satisfactory results, that is, merchantable candle-stock.

7. Q. What did you do with the free fat acids manufactured by heat and water alone? Did you submit it to another process before using it for candle-stock? If yea, what is that process?

A. We pressed the first decomposition in our hydraulic presses, as usual, with great care. The stock was dark, and of an unsaleable quality. We subsequently mixed it with its own hot pressings, which produced a worse result than the former. I allude in this answer to tallow alone. The lard stearim that we decomposed without the use of lime was crystalline, moderately, and pressed, tolerably white, but not as white as the product of the same stock treated by the old lime saponification process. Not being satisfied with the results of the decomposition in the boiler alone, we resorted to the distillation of the stock after its decomposition in the boiler. The result was a highly very satisfactory quality of fat acids, attended with considerable loss of material.

8. Q. Do you use any direct fire under the boiler, and how long have you so used it?

A. We have used it now and nearly all the time sinced we commenced, but we have used steam alone occasionally.

9. Q. How long a time was the operation of producing free fat acids by the use of heat and water alone?

A. In the decomposition of the stock, as thoroughly as I have already described, it took us about 13 hours after the pressure got up to 150 lbs. to the square inch.

10. Q. Do you now manufacture by Mr. Tilghman's process alone, or do you use other modes of manufacturing free fat acids at the same time?

A. We make no candles from the product of the stock decomposed in the Tilghman boiler alone. We make candles from the product of that boiler afterward distilled; also, from the product of the boiler not distilled, but mixed with other stock that has been acidified and distilled. We also make candles of stock that has been acidified and distilled, without any admixture of the product of the boiler.

11. Q. Do you use these several processes at the same time, one in connection with another, for the production of free fat acids?

A. We always use Mr. Tilghman's process in connection with another.

(Signed) C. H. GRANT.

231 APRIL 3D, 1860.

NATHANIEL ROPE, SR., sworn.

Examined by defendant's attorney:

1. Question. Please state your business; and, if you carry it on in Cincinnati, state in what part of the city, and how long you have been carrying it on, and in what name.

Answer. My business is the manufacture of star candles and lard-oil. I commenced this business with Gross and Dietrick, and others, in Cincinnati, in 1850. In 1855 I bought them out, and have since carried it on individually, but under the firm of N. Ropes & Co.

I have been carrying it on in Lock street, on the west side, between Third and Fifth streets, in Cincinnati.

2. Q. Please state in what way you have been in the habit of separating the glycerine from fatty substances prior to attempting doing it under Mr. Tilghman's patent process. Describe your process prior to that period, and how much lime or other chemicals you have been in the habit of using, in order to produce the separation of the glycerine from the fatty substances.

A. Prior to using Tilghman's process, we used about 13 per cent. of lime, and about double that quantity of sulphuric acid. We used open tubs. We dissolved our lime in water, and this was combined with the fatty substances in an open tub. We boiled it. We found it was cooked sufficiently by boiling 7 hours.

This formed what is called a lime-soap. I don't know all the technical terms. This is then put into what we call a decomposing tub, where it is combined with the sulphuric acid and boiled with it. When sufficiently boiled, it is dipped over into what we call our stock tub. It is then run into tin pans and cooled, and the cakes are pressed in the hydraulic presses.

The red oil and margerine is pressed out, and the candle-stock remains.

3. Q. Please state whether you have been working under Mr. Tilghman's process. If yea, how long have you been working under that process, and under whose direction or superintendence?

A. We have been working under it, or, I should say, rather we have been experimenting with his process, until lately. The reason I say experimenting is because Mr. Tilghman, when he first came here, informed me that he never had an opportunity of operating largely with lard stearine. We began experimenting about the beginning of January. These experiments were not satisfactory as to the quality of stock, until recently. The stock, apparently, was not well crystallized. The glycerine did not appear well separated from it. He has succeeded well recently. The stock, I may say, is beautifully crystallized. It is
232 so well crystallized, apparently, that we have no more trouble in separating the red oil and margerine than under the old process.

These experiments have been made under the superintendence of Mr. B. C. Tilghman.

4. Q. Please describe the process used in your manufactory under Mr. Tilghman's superintendence, in separating the glycerine from fatty substances; the kind of boiler used, the size of it, how it is heated, what degree of heat and pressure is used in the boiler, and how long it takes to separate the glycerine, so as to make an article ready for use; whether any and what quantity of lime or other substance is used in order to seperate the glycerine from the fatty substances.

A. It is done in a copper boiler, in a horizontal position, about 12 feet

long and 3 feet in diameter. It is heated up in part, say to about 45 degrees, by our old boiler. This heat is increased by a fire under the copper boiler, till a pressure is produced of about 150 pounds to a square inch. The stock is first melted in an open tub, and run into the copper boiler with one-half its bulk of water. This water is then drawn off, and the process is repeated with the same quantity of water. The time for cooking depends measurably upon the quantity of lime used in connection with the water. With no lime, a good stock, well crystallized, has been produced in 20 hours, with one-half per cent. of lime it usually takes about 6 hours, and probably it could be done in a shorter time with from 1 to 2 per cent. of lime. But under all circumstances the same pressure must be applied—that is, so far as our experience goes—we have never tested it under a lower pressure. If there is no lime used, we use no sulphuric acid. If we use one-half per cent. of lime, we use about 1 per cent. of sulphuric acid.

5. Q. Are you now making a merchantable stearic acid by this process of Mr. Tilghman's, without the use of any lime? If so, how much are you making in a day, and at what actual cost as compared with the old process?

A. We have only worked twice without the use of lime. The first time it was not all crystallized, nor did it give us satisfaction. The last time, as I said before, it was beautifully crystallized. But the objection to working in this way is the time it occupies, say 20 hours, to produce an unexceptionable article.

But by using from one-half to 2 per cent. of lime, the time may be reduced to say 6 hours with one-half per cent. of lime, and possibly to 4 or 5 hours with from 1 to 2 per cent., under the pressure before named. I don't know that I am prepared to state the comparative cost of the two processes, but I have no doubt there is a considerable saving of expense, by reason of the reduced quantity of the sulphuric acid used. We are making merchantable stearic acid with the use of lime, but we are
233 not making it without the use of lime. We have made a merchantable stearic acid without the use of lime, but are not doing so now. The objection is, as I said before, that it takes too much time to accomplish it without lime.

6. Q. Please state whether you have used or are now using the stearic acid made by the admixture of one-half to 2 per cent. of lime, for the purpose of making candles. If yea, how do such candles compare in quality with stearic acid made by the old process?

A. We are now using the stearic acid made by Mr. Tilghman's process for candles, &c., and it will compare very favorably with that made by the old process, and the candles are of a like quality. We are now using one-half per cent. of lime for making the stearic acid from which we make our candles.

7. Q. What do you understand by Mr. Tilghman's process? Is it to make stearic acid without the introduction of any lime, or with a portion of lime? If so, what portion?

A. I have no particular understanding what constitutes Mr. Tilghman's process, patently considered. One process he has introduced into our factory is to make stearic acid without the use of any lime. Another which he has introduced is to make it with a small portion of lime.

8. Q. How many of these boilers are at present in use in your factory, under Mr. Tilghman's superintendence? Is it your opinion that the process of making fat acids without the use of lime and sulphuric acids, considering the quantity you can make in a given time, the cost of ma-

chinery, and expense of heating, can be more profitably used by manufacturers than by the old mode?

A. One boiler under his superintendence. I am not prepared to say that it would be more profitable, without the use of any lime, to work in this way rather than in the old mode.

Cross-examined by B. C. Tilghman.

9. Q. Has there been any experiment made at your factory by Mr. Tilghman, either with or without the use of lime, in which there has not been some fat acid and glycerine formed from the fatty substance treated?

A. In the first experiment without the use of lime there was not a proper separation. It had a greasy appearance. I did not taste the glycerine water. In the last experiment without the use of lime the separation of glycerine appeared to be very perfect, as perfect as under the old process.

(Signed) N. ROPES.

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235 TESTIMONY.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK.

EUGENE GRASSELI, of lawful age, being first duly sworn, deposes and says:

Question 1, (by Mr. Fox, for defendant.) Please state your business, and how long you have followed it, and where.

Answer. I am a chemist. I have been a chemist since my six-twenty year, about thirty-four years; in France, and in Germany, and in this country. I have been in this country about twenty-four years. I have been in Cincinnati about twenty-two years, and all that time been chemist.

Question 2, (by same.) State how and in what manner you and other persons engaged in the same business with you have procured for fat acids and the solution of glycerine from fatty or oily substances. Please describe, as fully as you can, the means used for that purpose, and whether closed or open, and how you have applied the necessary heat. If you have, at various times, employed different means and apparatus, please describe them, and when these different modes were used.

Answer. This branch of manufacture—the manufacture of star candles—begun about 1830. They used one hundred pounds (100) of tallow, from twenty to twenty-four pounds of quicklime. By this process the glycerine is separated from the fatty acids, the glycerine remaining in the water, and the fatty acids forming a neutral soap with the lime. The neutral soap is then decomposed by the use of diluted sulphuric acid, until all the lime used is taken up or neutralized by the sulphuric acid. The residuum of the operation being sulphate of lime, which leaves the fatty acids entirely free. They are then exposed to crystallization in a cellar or cool place, and then pressed cold in a hydraulic press. This is the first operation. By the first pressing the oleic acid is expressed or separated, and the stearic and margaric acids remain, and is then pressed in a hydraulic press at a temperature of from 90 to 100 degrees Fahrenheit. By this operation the last remains of oleic acid are

236 separated, and the two acids, the stearic and margaric, are then ready to run into candles after being melted and treated the second time with a small quantity of diluted sulphuric acid.

For the saponification with lime they might use wooden tubs—open wooden tubs; but for the decomposition of the neutral soap, open wooden tubs, lined with lead, are necessary. Steam is used during the whole process by being passed through the liquids. I have never used different means, but, as chemist, know of them.

Previous to 1855 a new process was discovered in France, to use less lime in the saponification of the fatty acids, by the use of superheated steam in close vessels. By this process an acid soap is obtained instead of a neutral one, and consequently a less quantity of sulphuric acid is used for the decomposition of this acid soap. By these means the quantity of lime used has been reduced as low as four pounds to one hundred pounds of tallow. There is a condensed statement of the means used for this process in Wagner's Yearly Report. Previously to that time, about 1845 or 1848, experiments had been made by using superheated steam alone to decompose fatty acids, without the used lime or any other alkali's, the glycerine uniting with the water and leaving the fatty acids free; but this process is slow, and rather dangerous. The first process described here has been followed since 1850 by distillation in large copper stills by the use of superheated steam, the fatty substances having been previously treated with from four to six per cent. of concentrated sulphuric acid. This process is still in use. By superheated steam I mean a temperature of from four hundred fifty to six hundred degrees and above Fahrenheit.

Question 3, (by the same.) How much sulphuric acid do you use to neutralise a pound of quicklime?

Answer. I don't remember now, but there is always an excess of acid used.

Question 4, (by same.) Have you known that free fat acids and the solution of glycerine can be produced by heat and water alone? How long since, and how, have you ascertained this? If from scientific works, state the names of the works and publications, and when made, and where published. If from practical knowledge, state when and where.

Answer. I have known that free fat acids and the solution of glycerine can be procured by heat alone. I don't remember now the works in which I have read it, but the process is mentioned in Payen's Chemistry, edition of 1851, published in Paris, France. I read of this process previous of 1850. I have not practiced this myself, but I have known it to be in practical operation in this country, in Philadelphia, and I think England and France.

Question 5, (by same.) State your opinion whether it is, practically and economically speaking, possible to produce free fat
237 acids and solutions of glycerine from fatty or oily substances by the application of heat and water alone, without the use of other chemical substances with the fatty substances. If yea, what degree of heat is necessary for that purpose?

Answer. It is my opinion that this process cannot be used economically here in this country. It might be used in England, because labor and capital is cheaper. It would require about (600) six hundred degrees of heat with water alone.

Question 6. Can you state the quantity of lime and sulphuric acid, with the use of superheated steam introduced into a closed tank or vessel, necessary to produce free fat acids from one hundred (100)

pounds of fatty or oily substances? If yea, state; and what is the value, or cost, to the manufacturer, of such sulphuric acid and lime? State also the quantity of sulphuric acid and lime necessary to produce the same results when the fatty or oily substances is heated in a closed tank, without the use of superheated steam?

Answer. It is my opinion that half the quantity of lime-compound with that used formerly will be enough, by using superheated steam in close vessels, consequently half the quantity of sulphuric acid only is necessary, and the time of the operation is shorter by the use of superheated steam, and a better yield of fatty acid is obtained.

E. GRASSELI.

E. GRASSELI recalled.

Cross-examination:

Question 1, (by Mr. Tilghman, for plaintiff.) What is the date of the book containing the account of the process referred to in your answer to the second question, wherein the fat was heated with four (4) per cent. of lime in a close vessel?

Answer. It was Wagner's Yearly Report, of the year 1855.

Question 2, (by same.) Have you ever read an account of that process in any book previous to that date?

Answer. No, sir.

Question 3, (by same.) In speaking of an acid soap you do not mean a combination *combination* of a neutral soap with an excess of fat acids?

Answer. It is not a combination of neutral soap, but an acid soap altogether, in which fatty acids are in excess of the lime, which is used as a base.

E. GRASSELLI.

238 GRASSELLI.

Question by defendants. Please state what difference there is, if any, between the process of Mr. Tilghman and the process used by Mr. Werk, suppose the latter uses seven pounds of lime to one hundred pounds of fatty substance?

Answer. So far as I am acquainted with the process of Mr. Tilghman, his process consists in passing an emulsion of fats and water through a series of pipes heated at a high temperature. By this process the glycerine is separated from the fatty matters, and the fatty acids are left free. It might then be used for the manufacture of candles.

As far as I am acquainted with the process used by Mr. Werk, he uses a less quantity of lime than was used in the old process of forming a neutral soap. By using a less quantity of lime, and subjecting the fatty matters in presence of the lime and water to a current of superheated steam, a neutral soap is first obtained, which, by the help of superheated steam or increase of heat, has the tendency to free the balance of the fats used of their glycerine, and thus changing the whole compound to an acid soap, in which the fat acids are in excess. The smallest quantity of lime which has been found to answer this purpose is not less than four per cent. of the fatty matter. To free this acid soap from its base, (the lime,) sulphuric acid is used, but in less quantity than would have been necessary to decompose the neutral soap, while in the process of Mr. Tilghman there is no lime, and consequently no acid used at all.

Question 2, (by same.) What do you call the product of fatty sub-

stances when the glycerine is separated by means of lime and the lime separated by sulphuric acid?

Answer. In the first place, I call it an acid soap, so long as lime is with it, and after the lime is eliminated by sulphuric acid, they are free fatty acids.

Question 3, (by same.) Please state what you call the product of fatty substances by the action of water at a high temperature and pressure?

Answer. Free fatty acids and glycerine.

E. GRASSELLI.

EDWARD S. WAYNE, of lawful age, being first duly sworn, says and deposes:

Question 1, (by Mr. Fox.) Please state your business, and how long you have followed it, and where.

Answer. I am a chemist by profession, and have been engaged in it practically and scientifically the last fifteen years (15) in this city, and in Philadelphia previously.

Question 2, (by same.) Please state your knowledge of the mode and manner of producing free fat acids and the solution of
239 glycerine from fatty or oily substances. Describe the usual mode in which this is done, whether by heat alone, or by the use of heat with chemical substances mixed with the fatty or oily substances?

Answer. I am theoretically acquainted with the manufacturing of stearic acid and glycerine. There is one process by saponification, by means of lime, which forms a fatty soap with the lime, and free glycerine separated by decomposition is held in solution with the water present. To this lime-soap sulphuric acid is added, which decomposes it, forming sulphate of lime with the lime, and sets the fatty acids free. Another process, sulphuric acid itself is used as a saponifier. The acid combines with the glycerine and the fat acids are liberated. The fat acids after this treatment are washed with water to free them from the acid as much as possible, then placed in a copper still and distilled over by a current of superheated steam; sometimes an auxiliary fire is also placed under the bottom of the still, but this is not universal though. By this process the glycerine is lost—thrown away in combination with the sulphuric acid as a world product. The stearic acid distils over from the still, but not as pure stearic acid. It contains besides stearic acid solid hydro-carbons, mutual products of the decomposition of stearic acid and oleic acids by the action of heat; also accompanied with more or less acrolein'. A larger quantity by that process of candle-stock, I believe, can be obtained than by the former one, but I question its economy over the other process mentioned above, from the fact that the oleic acid obtained has much less market-value than the other.

Another process that I am acquainted with also, is the reducing the quantity of lime mentioned in the first instance, say down to one-fourth, (say from fifteen to twenty pounds to one hundred pounds of fat are used in the first process,) placing the lime and fat in a suitable close vessel and applying either superheated steam or pressure, producing thereby an acid soap. Stearic acid is a tribasic body, that is, it will combine with one, two, or three equivalents of a base by a base—I mean lime, potash, soda, and hydrogen. Now this acid soap is a stearic soap, containing one equivalent of lime and two equivalents of hydrogen, obtained by the decomposition of water in this process. This acid lime-soap consequently requires only one-third of the quantity of acid to decompose it into fatty acids, as would require to be used in the first process mentioned.

I am also acquainted with two other processes by the use of superheated steam alone. The first, that by Mr. Tilghman, by passing a mixture of oil and water through a coil of pipe heated to a temperature between six and seven hundred of Fahrenheit of heat. Decomposition ensues by the process, and free fatty acids and glycerine are ob-
240 tained in this process. The elements of water, oxygen, and hydrogen are the elements of the decomposition, being held in very slight union at the temperature to which they are submitted; the hydrogen acting as it were as above for the acids.

I am also acquainted with a process somewhat in its principles parallel, but practically different: by merely transmitting a current of superheated steam into a still containing the neutral fatty bodies, causing free fatty acids and free glycerine to distill over. In both these processes the glycerine is carried over mechanically by the steam acting as a carrier, as glycerine will not distill per se without decomposition. I am also acquainted with another process, in which are alkalies. Potash is used as a saponifier. To this soap, alumina, in the form of clay or otherwise, is added, which decomposes the soda-soap, the fatty acids combining with the alumina, the potash being set free. This alumina soap is decomposed by means of sulphuric acid. The waste product thus being made a source of profit, being thus converted into a double sulphate of alumina and potash, commercially known as alum.

Another process is saponification by means of chloride of zinc acting chemically on neutral fats, decomposing them into fatty acids and glycerine. This process may be economical, as nearly the whole of the chloride of zinc used may be obtained back again. The decomposing power of the chloride of zinc illustrates the action exercised by superheated steam upon these fatty bodies, viz: The decomposition of water, and the fixation of oxygen and hydrogen liberated between the fatty acids and the glycerine. This last process has been used in South America for the purpose of forming the fatty acids, stearic.

Question 3, (by same.) Have you knowledge that free fat acids and the solution of glycerine can be produced by heat and water alone? If yea, how long since, and how have you ascertained this? If from scientific books or works, state the names of the works and publications, and where made and where published? If you have practical knowledge, state when and where?

Answer. I have known free fat acids and glycerine to be obtained by the fixation of the elements of water through the agency of heat and steam. This decomposition is mentioned by Payne, a work published in Paris in the year 1851. I have had access to a copy almost ever since it came to this country. I have had a copy about five years. I have had access to a copy since the fall of 1851, or the spring of 1852. My copy is a German copy. It is also stated in Regnault. My Regnault is an American edition. The publication of that edition I cannot tell. It was published in Philadelphia by Lippencott & Co., I think. I got one of their first copies. It was published, I think, eight or nine years ago. Well, I may safely say that I have known this thing as a gen-
241 eral chemical fact for this last (9 or 10) nine or ten years. I have never practically been engaged in the business, although I have frequently been consulted in regard to the matter by manufacturers. From descriptions contained in the books above referred to, connected with my general knowledge of chemistry, I can carry out the process of decomposition by stearic and heat.

Question 4, (by same.) State whether, in your opinion, it is, practically and economically speaking, possible to produce free fat acids and

solutions of glycerine from fatty or oily substances, by the application of heat and water alone, without the use of other chemical substances with the fatty substances? If yea, what degree of heat is necessary for that purpose?

Answer. I believe it is, but I do not think that the process of Mr. Tilghman is a practicable process, economically considered. The wear and tear of apparatus would increase the cost of production too much. By wear and tear, I mean destruction of pipes, and the small quantity that could be operated upon in a given time. Experimentally it is a very perfect process, so far as the theory involving the process is concerned. A distillation of that kind can be produced by a temperature of from, say, between five hundred and fifty (550) and six hundred and fifty (650) degrees of Fahrenheit. I believe steam and heat are used alone in decomposing neutral fat bodies at present by Messrs. Price & Co., of London, thereby producing glycerine and the fat acids.

Question 5, (by same.) Can you state the quantity of lime and sulphuric acid, with the use of superheated steam introduced into a closed tank or vessel, necessary to produce free fat acids from one hundred pounds of fatty or oily substances? If yea, state; and what is the value or cost to the manufacturer of such sulphuric acid and lime? State, also, the quantity of sulphuric acid necessary to produce the same result when the fatty or oily substances is heated in a closed tank without the use of superheated steam.

Answer. The quantity of lime used where superheated steam is used in close vessels with water, is five pounds to one hundred pounds of fat. The same quantity is necessary, also, when heat alone is used with water. The principle involved in both is the same. By the means of pressure you increase the boiling point of water, consequently you obtain the desired temperature. Temperature alone is necessary. By the use of superheated steam, you obtain the same end in close vessels. I allude here to close vessels. The quantity of sulphuric acid required is, of course, reduced. For instance, if fifteen pounds of lime were used by the old process, you would ordinarily require about thirty-five pounds of ordinary sulphuric acid to decompose the lime-soap. By reducing the lime to, say, five (5) pounds, from eleven to twelve pounds of acid alone would be required. It would take little over two pounds of acid to a pound of lime.

242 Question 6, (by same.) You have alluded to Mr. Tilghman's mode or method of producing free fatty acids by heat. Please state what other modes can be resorted to in order to produce the same result. Is it necessary to have a heavy pressure in order to prevent the conversion of the water into steam during the process?

Answer. No, sir; the process is not absolutely necessary. To prevent the conversion of water into steam, I do not consider that pressure is necessary. Steam being thrown in a superheated state in excess, a portion of it decomposing and acting chemically, would reduce the fatty bodies into the fat acids and glycerine. The excess of steam escaping from the still would carry over the glycerine mechanically, and also facilitate the distillation over of the stearine acids. It is necessary to have a pressure to prevent water from being converted into steam. I can heat water red-hot, if I can confine it long enough; and again I can throw water on a red-hot iron, which will evaporate very slowly from the heated surface, it assuming what is well known as the spheroidal condition, the philosophy of which it is not necessary to explain.

Question 7, (by same.) Please state whether you have examined the specifications to Mr. Tilghman's patent. If yea, how he produces a

pressure to prevent the water being converted into steam? State also whether the same degree of heat can be obtained without adopting that mode of pressure.

Answer. The plan Mr. Tilghman adopts is by means of a loaded safety-valve. The same degree of heat could be obtained otherwise.

E. S. WAYNE.

N. ROPES, duly cautioned and sworn, deposeth as follows:

Question, (by defendant's counsel.) Please state your business; and if you carry it on in Cincinnati, state in what part of the city, and how long you have been conducting the business, and in what name.

Answer. My business is the manufacture of star candles and lard oil. I commenced this business with Gross & Dietrich, in the city of Cincinnati, in the year 1850. In 1855, I bought them out, and have since carried it on individually, but under the firm name of N. Ropes & Co. I have been, and am now, carrying it on on the west side of Lock street, between Third and Fifth streets, in the city of Cincinnati.

Question 2, (by same.) Please state in what way you have been in the habit of separating glycerine from fatty substances, prior to attempting doing it under Mr. Tilghman's patent process. Describe your
243 process prior to that period, and how much lime or other chemicals you used in order to produce the separation of the glycerine from the fatty substances.

Answer. Prior to using Mr. Tilghman's process, we used about thirteen (13) per cent. of lime, and about double that quality of sulphuric acid. We used open tubs. We dissolved our lime in water, and then this was combined with the fatty substances in an open tub. We found it was cooked sufficiently by boiling it seven (7) hours. This formed what is called a lime-soap. I do not know all the technical terms. This was then put into what we called a decomposing tub, where it was combined with sulphuric acid, and boiled up with it. When sufficiently boiled, it was turned into what is called the stock tub. It was then run into pans and cooled, and the cakes were afterwards pressed in the hydraulic press. The red oil and margarine were pressed out, and the candle-stock remained.

Question 3, (by same.) Please say whether you have been working under Mr. Tilghman's process. If yea, how long have you been working under that process, and under whose direction and superintendence?

Answer. We have been working under it, or I should say, rather, we have been experimenting with his process until lately. The reason I say experimenting, is, because when Mr. Tilghman first came here, he informed me he had never an opportunity of operating largely with lard stearine. We began experimenting about the beginning of January, 1860. These experiments were not satisfactory as to the quality until recently. The stock, apparently, was not well crystalized. The glycerine did not appear to be well separated from it. He has succeeded well recently. The stock, I may say, is beautifully crystalized. It is so well crystalized, apparently, that we have no more trouble in separating the margarine and red oil, than under the old process. These experiments have been made under Mr. B. C. Tilghman's superintendence.

Question 4, (by same.) Please describe the process used at your manufactory under M. Tilghman's superintendence, in separating the glycerine from fatty substances; the kind of boiler used, the size of it, how it is heated, what degree of heat and pressure is used under this process in the boiler, and how long it takes to separate the glycerine, so as to make an article for use; whether any, and what quantity of lime or

other substance is used, in order to separate the glycerine from the fatty substances.

Answer. It is done in a copper boiler, about twelve (12) feet long and three (3) feet in diameter. It lays in a horizontal position. It is heated up, in part, say about (45°) forty-five degrees from our own boiler.

244 This heat is increased by a fire under the copper boiler, till a pressure is produced of about (150) one hundred and fifty pounds to the square inch. The stock is first melted in an open tub, and then run into this boiler with one-half of its bulk in water. This water is then drawn off, and the process is repeated with the same quantity of water. The time for cooking depends measurably upon the quantity of lime used in connection with the water. With no lime, a good stock, well crystalized, has been produced in twenty (20) hours. With one-half per cent. of lime, it usually takes about six hours, and probably it could be done in a shorter time, with from one (1) to two (2) per cent. of lime. But under all circumstances the same pressure must be applied, so far as our experience goes. We have never tested it under a lower. If there is no lime used, we use no sulphuric acid. If we use one-half per cent. of lime, we use about one per cent. of sulphuric acid.

Question 6, (by same.) Are you now making a merchantable stearic acid by this process of Mr. Tilghman, without the use of any lime? If so, how much are you making in a day, and at what actual cost, as compared with the old process?

Answer. We have only worked twice without the use of lime. The first time it was not crystalized, nor did it give us satisfaction. The last time, as I said before, it was beautifully crystalized; but the objection to working this way is the time it occupies, say twenty (20) hours to produce an unexceptionable article. But by using from one-half to two per. cent. of lime, the time may be reduced to, say six hours, with one-half per cent. of lime, and possibly to four (4) or five (5) hours, with from one to two per cent. of lime, under the pressure before named. I don't know that I am prepared to say what is the comparative cost of the two processes; but I have no doubt there is a considerable saving in expense by reason of the reduced quantity of vitriol or sulphuric acid used. We are making merchantable stearic acid with the use of lime, but we are not making it without the use of lime at present.

We have made a merchantable stearic acid without the use of lime, but we are not doing so now. The objection, as I said before, is, that it requires too much time in accomplishing it without lime.

Question 7, (by same.) Please state whether you have used, or are using now, the stearic acid made by the admixture of from one-half ($\frac{1}{2}$) to two (2) per cent. of lime, for the purpose of making candles. If yea, how do such candles compare in quality with stearic acid made by the old process?

Answer. We are using the stearic acid made by Mr. Tilghman's process for candles, and it will compare very favorably with that made by the old process, and the candles are of a like quality. We are now using one-half ($\frac{1}{2}$) per cent. of lime for making stearic acid, from which we make our candles.

245 Question 8, (by same.) What do you understand by Mr. Tilghman's process? Is it to make stearic acid without the use of any lime, or with a certain proportion of lime? If so, what proportion?

Answer. I have no particular understanding what constitutes Mr. Tilghman's process, patently considered. The process he has introduced into our factory is to make stearic acid without any lime. Another process he has introduced is to make it with a small quantity of lime.

Question 9, (by same.) How many boilers are at present in use in your factory, under Mr. Tilghman's superintendence? Is it your opinion that the process of making a fat acid, without the use of lime and sulphuric acid, considering the quantity you can make in a given time, the cost of machinery and expense of heating, can be more profitably used by manufacturers than by the old mode?

Answer. We have one boiler under his superintendence. I am not prepared to say that it would be more profitable, without the use of any lime, to work in this way than by the old way.

Cross-examination by Mr. B. C. Tilghman, agent for the plaintiff:

Has there been any experiment made at your factory, by Mr. Tilghman, either with or without the use of lime, in which there has not been some fat acid and glycerine formed from the fatty substance treated?

Answer. In the first experiment, without the use of lime, there was not a proper separation. It had a greasy appearance. I did not taste the glycerine water. In the last experiment, without the use of lime, the separation of glycerine appeared to be very perfect—as under the old process.

NATH. ROPES.

CHARLES H. GRANT, being duly sworn, deposes and says:

Question 1, (by Mr. Fox, for defendant.) Please state what is your business, and where you are following it, and how long you have followed it.

Answer. My business is the manufacture of adamantine candles, in the city of Philadelphia. I have been engaged in the business there about nine years.

Question 2. Please state in what way you have separated the glycerine from the fatty substances used in the manufacture of stearic acid candles?

Answer. By saponification in an open tub, with twelve to fourteen per cent. of lime. This was our first process. We then employed the process of acidifying; that is, pouring in the oil of vitriol on the fat,
246 heated up to a high point; afterwards completing the process by distillation. Subsequently, we used a third process, by the use of a close copper tank, with water, with a pressure of one hundred and fifty pounds to the square inch, or thereabouts; sometimes without any lime; sometimes about one-half per cent.; sometimes with one per cent. of lime.

Question 3. What is the result when water and heat alone are used?

Answer. The result is a decomposition of this into glycerine and fat acids, which were not as perfect, in our opinion, as with the use of lime.

Question 4. Could you compete with other manufacturers, by obtaining free fat acids by the agency of water and heat alone?

Answer. As far as our experiments have gone, I don't think we could. If we were to attempt it, we would want to experiment with a larger proportion of water, or repeat the process by drawing out the glycerine-water and rechanging with fresh water.

Question 5. What do you call the process for the manufacture of free fat acids by the use of fat, water, and heat alone? Whose is it, and how long have you been experimenting with it?

Answer. We have called it the Tilghman process. We have been experimenting with it, working with it, for seven or eight months. I purchased the process from Mr. Tilghmam, the plaintiff in this suit.

Question 6. After having obtained the free fat acids by heat and water, do you subject them to distillation in order to obtain a pure white stearic acid by the usual mode of pressing?

Answer. We have worked it by distillation, and by mixing the product of the copper boiler with other stock that had been distilled. I am not positively certain that we have ever mixed the product of the copper boiler that had been decomposed by water alone, without lime; but we have frequently mixed the stock which had been decomposed by the use of one-half per cent. of lime and obtained satisfactory results, merchantable candle-stock.

Question 7. What did you do with the free fat acids manufactured by heat and water alone? Did you submit it to another process, before using it for candle-stock? If yea, what is the process?

Answer. We pressed the first decompositions in our hydraulic presses as usual with great care. The stock was dark, and of an unsaleable quality. We subsequently mixed it with its own hot pressing, which produced a worse result than the former. I allude in this answer to tallow alone. The lard stearine that we decomposed without the use of lime, was crystalline, moderately, and pressed tolerably white, but not as white as the product of the same stock treated by the old lime saponification process. Not being satisfied with the result of the de-
247 compositions in the boiler alone, we resorted to distillation of the stock after its decomposition in the boiler. The result was very highly satisfactory quality of fat acids, attended with considerable loss of materials.

Question 8. Do you use any direct fire under the boiler? If yea, how long have you used it?

Answer. We have used it nearly all the time since we commenced. But we have used steam alone occasionally.

Question 9. How long a time was the operation of producing free fat acids by heat and water alone?

Answer. In the decomposition of the stock as thoroughly as I have already described, it took us about thirteen hours after the pressure got up to one hundred and fifty pounds to the square inch.

Question 10. Do you now manufacture by Mr. Tilghman's process alone, or do you use other modes of manufacturing free fat acids at the same time?

Answer. We make no candles from the product of the stock decomposed in the Tilghman boiler alone. We make candles from the product of that boiler afterwards distilled; also from the product of the boiler not distilled, but mixed with other stock that has been acidified and distilled. We also make candles from the products of the stock decomposed in the Tilghman's boiler alone. We make candles from the product of that boiler afterward distilled, also from the product of the boiler not distilled, but mixed with other stock that has been acidified and distilled. We also make candles of stock that has been acidified and distilled. We also make candles and stock that has been acidified and distilled, without any admixture of the product of the boiler.

Question 11. Please state whether or not you use these several processes at the same time, one in connection with another, for the production of free fat acids.

Answer. We always use Mr. Tilghman's process in connection with another.

C. H. GRANT.

Cross-examination waived by plaintiff's solicitor.

JAMES GAMBLE, of lawful age, being first duly sworn, deposes and says:

Question 1, (by Mr. Fox.) Please state what business you are in, and how long you have followed it, and in what place?

Answer. I am one of the firm of Proctor & Gamble. I am engaged in the manufacturing of soap and candles, on Western Row, between York and Dayton streets, in the city of Cincinnati. I have been in the business about thirty-eight years, and in that place about twenty-three years.

Question 2, (by same.) State how and in what manner you and
248 other persons engaged in the same business have procured free fat acids and the solution of glycerine from fatty or oily substances. Please describe, as fully as you can, the means used for that purpose, the kind of tank used for the purpose, and whether closed or open, and how you have applied the necessary heat. If you have at various times employed different means and apparatus, please describe them, and when these different modes were used.

Answer. We at first procured it by applying fourteen pounds of lime to one hundred pounds of fat substance, with a quantity of water heated by steam. We first employed an open vessel, and the steam was applied by a pipe going down to the bottom of the vessel. When the substance was properly united, we covered the vessels as close as possible with boards, to get as much pressure with steam as we could. We continued this process for about three years; then we made a change by putting a second cover on the tub to procure more pressure in the vessel. We commenced the stearic acid business in 1850. About 1853 we made the change above referred to, that we put the second cover on. The first cover was inside of the tub. The second cover was
and put on top, so as to make it as fast as possible. Part of the second top cover was fastened down, nailed down, the other part was slipped on tight to it. Whether there was a or not, I don't know. Part of these works gave away and we never replaced them. We continued on this two or three years before they gave away. Then we continued on until 1858 with only one cover. Then we procured a tank, iron tank, made of boiler-iron, close. We introduced steam by a pipe in the bottom running horizontal, having an agitator inside, which is composed of a shaft going through the center of the tank, and having two arms, into which was inserted two pieces of iron running from one to the other, to agitate the substance in the tank. The steam is got into the bottom of the vessel by a pipe leading direct from the boilers. To every hundred pounds of stock, fatty substance, we introduced from five to six pounds of lime. We used a less quantity of water than with the open vessel. There was less quantity of water than of grease. We used no fire heat in the tank. For about three months we used h[illegible] under the tank in addition to the steam, but we use none now. W[illegible] used a pressure of one hundred and ten pounds on the boiler by the *guage*, but the degree of heat in the tank I don't know, but it would be about the same pressure in the tank as on the boiler. By pressure, I mean the pressure as measured on the boiler by the steam *guage*. We have used a thermometer, but the exact degree of heat I can't say now.

The time occupied in the first mode of process with the open tub
249 was about eight hours, I believe, and the last mode of process, by means of the tank, about five hours, from four to six. After the above process or operation is completed, we then put this substance into a [decomposing] tub, and introduce three pounds of sulphuric acid

diluted with water, to one pound of lime. In both modes of process we used the same proportion of sulphuric acid to like weight of lime.

Question 3, (by same.) Please state why you use five pounds of lime to one hundred pounds of fat; will not less quantity answer the purpose?

Answer. We find that a less quantity will not answer; we have had to increase a little over that.

Question 4, (by same.) Please state how many other manufacturers in Cincinnati have used the same process, and name them?

Answer. I can't tell how many others there are at present. Mr. Jones at present uses the same process—Jones & Conahan, and that is all I know of.

JAMES GAMBLE.

ANDREAS SPIES, of lawful age, being first duly sworn, deposes and says:

Question 1, (by Mr. Fox.) Please state in whose employ you are, and how long you have been so engaged, and in what capacity?

Answer. I am in the employ of Mr. Werk, the defendant in this case. I have worked for him over sixteen years, in his factory in Cincinnati. I have cooked his stearine during that time.

Question 2, (by same.) State how you have cooked the stearine at Mr. Werk's for the last two years?

Answer. I cook them in a tank. I use lime and water. I use five, six, and seven pounds of lime to one hundred pounds of fat. I generally use seven pounds, that is the best. I use about five thousand pounds [water] to seven thousand pounds of fat. That is about what the tank holds. The steam is conducted from the boiler through pipes to the bottom of the tank, and the steam pipes through which the steam goes are heated so as to increase the heat of the steam before it gets into the tank. The steam in the tank is heated from three hundred and thirty-six (336) to three hundred and fifty (350) degrees, as measured by the thermometer. We don't use a pressure-*guage* at the boiler now; we used to use one. The pressure on the steam boiler is from one hundred and ten (110) to one hundred and twenty (120) pounds, as indicated by the steam-*guage* at the boiler. The steam escapes from a pipe from the top of the tank, going up to the third story. The pressure in the tank is about the same as in the boiler. If the steam pressure was greater in the tank, the contents of the tank would run back in the boiler. There is a safety-valve at the boiler, and also one at the tank.

250 Question 3, (by same.) Please state how much lime you used in procuring fat acids in Mr. Werk's manufactory prior to using the superheated steam?

Answer. Before the using of the tank in cooking, I used from eleven (11) to fourteen (14) pounds to do best. The tubs were open, with boards on the top; [we did not] put weights on the boards.

Question 4, (by same.) State whether you have tried the effect of using less than five pounds of lime to one hundred pounds of fatty substance at the manufactory of Mr. Werk, with the use of superheated steam? If yea, what was the result of using less than five pounds?

Answer. I have tried to cook with less than five pounds of lime to one hundred pounds of fatty substance, and it was not good; and I have tried with five, and it was not as good as with six; and I have tried with six, and it was not as good as seven. I have found seven pounds to be the best.

ANDREAS SPIES.

FRANCIS X. WIEDEMER, of lawful age, being first duly sworn, deposes and says:

Question 1, (by Mr. Fox.) Please state what business you are in, and how long you have followed it, and in what place?

Answer. I am in the soap and star candle manufactory, in Cincinnati. I have been in the business for myself, since the year 1838. That is my trade. I learned it when I was a boy. My factory is the corner of the Fifth and Miami Canal, and my store is on Front between Main and Walnut.

Question 2, (by same.) State how and in what manner you and other persons engaged in the same business with you have procured free fat acids, and the solution of glycerine from fatty or oily substance. Please describe, as fully as you can, the means used for that purpose, the kind of tanks used for the purpose, and whether closed or open, and how you have applied the necessary heat. If you have, at different times, employed different means and apparatus, please describe them, and where those different modes were used.

Answer. We first began to manufacture star candle in the year 1847, in Cincinnati. At first we used open tubs. When we had materials in we had them slightly covered with planks to keep the heat in as much as possible. We heated with steam introduced into the bottom of the tub by pipes spread around through the bottom. These pipes had holes in them, through which the steam passed. At that time the pressure upon the boiler was from 60 to 75 pounds. We continued that process until about the year 1854 or 1855. We used from 11 to 14 pounds of lime to 100 pounds of fat, under the old process. It
251 took us then from 6 to 8 hours to boil the fat, usually from 7 to 7½ hours. We used at that time water in the tub; about one-third as much water as grease, I suppose, though I cannot say for certain what proportion. In 1854 or 1855, I believe in 1855, we changed our mode by largely increasing the size of our tubs, making them about double the size, and lined them with lead all over inside. We increased our tubs in the height principally, so that now they are about 5½ to 6 feet in diameter. We introduced the steam at the bottom of the tub the same as before, but increasing the bottom steam-pipes to about three times the former size. We increased the steam so that we use from 75 to 90 pounds of steam at the boiler. The tub is open until the materials are all in, then we close it up and put planks on close together, and weight it down with heavy iron bars, with rags on the tops of the planks, to prevent the steam from going through the joints, the iron being on the rags. Since making the above alteration, we have used first 11 pounds of lime to 100 pounds of fatty substances, we then put down to 10, and gradually have reduced it to 9 pounds; and we regularly now use only 9 pounds of lime to 100 pounds of fat. While we are boiling in the tubs, we keep the steam in the boiler for 80 to 90 pounds. It takes about as long now to boil as it used to under the old process.

F. X. WIEDEMER.

The further taking of depositions is adjourned till Monday, Feb. 13, 1859, at 2 p. m.

B. J. HORTON, *Not. Pub.*

Adjourned to Feb. 21st, between hours stated in notice.

B. J. HORTON, *Not. Pub.*

MONDAY, *Feb. 21st*, 1860.—Continuation pursuant to last adjournment.

GEORGE SHILLITO, of lawful age, being first duly sworn, deposes and says:

Question 1, (by attorney for defendant.) Please state your business, and how long you have followed it, and where.

Answer. My business is the manufacturing of oil, candles, and soaps. I have followed it between ten and eleven years, in Cincinnati.

Question 2, (by same.) Please state your knowledge of the mode and manner of procuring free fat acids, and the solution of glycerine from fatty or oily substances. Describe the usual mode in which this is done, whether by heat alone, or by the use of heat with chemical substances mixed with the fatty or oily substances.

252 Answer. When we first commenced, we mixed the stearine or stock with from (12 to 14) twelve to fourteen pounds of lime; we put water in, and boiled it by steam. This converted into what we call a soapy substance, a lime-soap. Then, by the use of sulphuric acid, decomposed it. We are now working under Mr. Werk's patent. Instead of using open tubs as formerly, we saponify now in close tanks.

Question 3, (by same.) What causes saponification in the presence of lime and water now; does heat or pressure; and what degree of heat do you use in your new mode?

Answer. The heat and nothing else causes saponification, and, as near as I can judge, we are using (300 to 350) three hundred to three hundred and fifty degrees of Fahrenheit. We could get up a hydraulic pressure that would destroy the tank and everything in it, without producing any saponification. The pressure would not do three works. We are now using seven pounds of lime to one hundred pounds of fat and sulphuric acid in proportion.

Question 4, (by same.) Did your ever saponify by superheated steam in an open tub, and what was the result?

Answer. We have. The result was that we produced the same stock, except the color was not as good as it ought to be. I tried it but once; attempted it the second time, but the pipes broke. The reason the color was not good was because we had not water enough, I believe. I believe that it can be done in open tubs by using superheated steam with seven pounds of lime.

Question 5, (by same.) How much lime had you in when you tried it by the use of superheated steam in open tubs?

Answer. (7) seven pounds.

Question 6, (by same.) How much does it cost you to convert (100) one hundred pounds of natural fat to fatty acid in your present mode of manufacture?

Answer. We are using (7) seven pounds of lime, which costs about three and a half cents, (17½) seventeen and a half pounds of sulphuric acid, which costs about forty-six and a half cents, making altogether about fifty cents.

Question 7, (by same.) Do you know of the new method for which Richard A. Tilghman has procured a patent? What is his process, the principle of it?

Answer. Yes. The principle, as I understand it, is to produce stearic acid by steam and water.

Question 8, (by same.) How much less would that process cost than the process you are using now, if it could be done in a reasonable time, supposing the labor to be the same in both cases?

FRANCIS X. WIEDEMER, of lawful age, being first duly sworn, deposes and says:

Question 1, (by Mr. FOX.) Please state what business you are in, and how long you have followed it, and in what place?

Answer. I am in the soap and star candle manufactory, in Cincinnati. I have been in the business for myself, since the year 1838. That is my trade. I learned it when I was a boy. My factory is the corner of the Fifth and Miami Canal, and my store is on Front between Main and Walnut.

Question 2, (by same.) State how and in what manner you and other persons engaged in the same business with you have procured free fat acids, and the solution of glycerine from fatty or oily substance. Please describe, as fully as you can, the means used for that purpose, the kind of tanks used for the purpose, and whether closed or open, and how you have applied the necessary heat. If you have, at different times, employed different means and apparatus, please describe them, and where those different modes were used.

Answer. We first began to manufacture star candle in the year 1847, in Cincinnati. At first we used open tubs. When we had materials in we had them slightly covered with planks to keep the heat in as much as possible. We heated with steam introduced into the bottom of the tub by pipes spread around through the bottom. These pipes had holes in them, through which the steam passed. At that time the pressure upon the boiler was from 60 to 75 pounds. We continued that process until about the year 1854 or 1855. We used from 11 to 14 pounds of lime to 100 pounds of fat, under the old process. It
251 took us then from 6 to 8 hours to boil the fat, usually from 7 to 7½ hours. We used at that time water in the tub; about one-third as much water as grease, I suppose, though I cannot say for certain what proportion. In 1854 or 1855, I believe in 1855, we changed our mode by largely increasing the size of our tubs, making them about double the size, and lined them with lead all over inside. We increased our tubs in the height principally, so that now they are about 5½ to 6 feet in diameter. We introduced the steam at the bottom of the tub the same as before, but increasing the bottom steam-pipes to about three times the former size. We increased the steam so that we use from 75 to 90 pounds of steam at the boiler. The tub is open until the materials are all in, then we close it up and put planks on close together, and weight it down with heavy iron bars, with rags on the tops of the planks, to prevent the steam from going through the joints, the iron being on the rags. Since making the above alteration, we have used first 11 pounds of lime to 100 pounds of fatty substances, we then put down to 10, and gradually have reduced it to 9 pounds; and we regularly now use only 9 pounds of lime to 100 pounds of fat. While we are boiling in the tubs, we keep the steam in the boiler for 80 to 90 pounds. It takes about as long now to boil as it used to under the old process.

F. X. WIEDEMER.

The further taking of depositions is adjourned till Monday, Feb. 13, 1859, at 2 p. m.

B. J. HORTON, *Not. Pub.*

Adjourned to Feb. 21st, between hours stated in notice.

B. J. HORTON, *Not. Pub.*

MONDAY, *Feb.* 21*st*, 1860.—Continuation pursuant to last adjournment.

GEORGE SHILLITO, of lawful age, being first duly sworn, deposes and says:

Question 1, (by attorney for defendant.) Please state your business, and how long you have followed it, and where.

Answer. My business is the manufacturing of oil, candles, and soaps. I have followed it between ten and eleven years, in Cincinnati.

Question 2, (by same.) Please state your knowledge of the mode and manner of procuring free fat acids, and the solution of glycerine from fatty or oily substances. Describe the usual mode in which this is done, whether by heat alone, or by the use of heat with chemical substances mixed with the fatty or oily substances.

252 Answer. When we first commenced, we mixed the stearine or stock with from (12 to 14) twelve to fourteen pounds of lime; we put water in, and boiled it by steam. This converted into what we call a soapy substance, a lime-soap. Then, by the use of sulphuric acid, decomposed it. We are now working under Mr. Werk's patent. Instead of using open tubs as formerly, we saponify now in close tanks.

Question 3, (by same.) What causes saponification in the presence of lime and water now; does heat or pressure; and what degree of heat do you use in your new mode?

Answer. The heat and nothing else causes saponification, and, as near as I can judge, we are using (300 to 350) three hundred to three hundred and fifty degrees of Fahrenheit. We could get up a hydraulic pressure that would destroy the tank and everything in it, without producing any saponification. The pressure would not do three works. We are now using seven pounds of lime to one hundred pounds of fat and sulphuric acid in proportion.

Question 4, (by same.) Did your ever saponify by superheated steam in an open tub, and what was the result?

Answer. We have. The result was that we produced the same stock, except the color was not as good as it ought to be. I tried it but once; attempted it the second time, but the pipes broke. The reason the color was not good was because we had not water enough, I believe. I believe that it can be done in open tubs by using superheated steam with seven pounds of lime.

Question 5, (by same.) How much lime had you in when you tried it by the use of superheated steam in open tubs?

Answer. (7) seven pounds.

Question 6, (by same.) How much does it cost you to convert (100) one hundred pounds of natural fat to fatty acid in your present mode of manufacture?

Answer. We are using (7) seven pounds of lime, which costs about three and a half cents, (17½) seventeen and a half pounds of sulphuric acid, which costs about forty-six and a half cents, making altogether about fifty cents.

Question 7, (by same.) Do you know of the new method for which Richard A. Tilghman has procured a patent? What is his process, the principle of it?

Answer. Yes. The principle, as I understand it, is to produce stearic acid by steam and water.

Question 8, (by same.) How much less would that process cost than the process you are using now, if it could be done in a reasonable time, supposing the labor to be the same in both cases?

FRANCIS X. WIEDEMER, of lawful age, being first duly sworn, deposes and says:

Question 1, (by Mr. Fox.) Please state what business you are in, and how long you have followed it, and in what place?

Answer. I am in the soap and star candle manufactory, in Cincinnati. I have been in the business for myself, since the year 1838. That is my trade. I learned it when I was a boy. My factory is the corner of the Fifth and Miami Canal, and my store is on Front between Main and Walnut.

Question 2, (by same.) State how and in what manner you and other persons engaged in the same business with you have procured free fat acids, and the solution of glycerine from fatty or oily substance. Please describe, as fully as you can, the means used for that purpose, the kind of tanks used for the purpose, and whether closed or open, and how you have applied the necessary heat. If you have, at different times, employed different means and apparatus, please describe them, and where those different modes were used.

Answer. We first began to manufacture star candle in the year 1847, in Cincinnati. At first we used open tubs. When we had materials in we had them slightly covered with planks to keep the heat in as much as possible. We heated with steam introduced into the bottom of the tub by pipes spread around through the bottom. These pipes had holes in them, through which the steam passed. At that time the pressure upon the boiler was from 60 to 75 pounds. We continued that process until about the year 1854 or 1855. We used from 11 to 14 pounds of lime to 100 pounds of fat, under the old process. It
251 took us then from 6 to 8 hours to boil the fat, usually from 7 to 7½ hours. We used at that time water in the tub; about one-third as much water as grease, I suppose, though I cannot say for certain what proportion. In 1854 or 1855, I believe in 1855, we changed our mode by largely increasing the size of our tubs, making them about double the size, and lined them with lead all over inside. We increased our tubs in the height principally, so that now they are about 5½ to 6 feet in diameter. We introduced the steam at the bottom of the tub the same as before, but increasing the bottom steam-pipes to about three times the former size. We increased the steam so that we use from 75 to 90 pounds of steam at the boiler. The tub is open until the materials are all in, then we close it up and put planks on close together, and weight it down with heavy iron bars, with rags on the tops of the planks, to prevent the steam from going through the joints, the iron being on the rags. Since making the above alteration, we have used first 11 pounds of lime to 100 pounds of fatty substances, we then put down to 10, and gradually have reduced it to 9 pounds; and we regularly now use only 9 pounds of lime to 100 pounds of fat. While we are boiling in the tubs, we keep the steam in the boiler for 80 to 90 pounds. It takes about as long now to boil as it used to under the old process.

F. X. WIEDEMER.

The further taking of depositions is adjourned till Monday, Feb. 13, 1859, at 2 p. m.

B. J. HORTON, *Not. Pub.*

Adjourned to Feb. 21st, between hours stated in notice.

B. J. HORTON, *Not. Pub.*

MONDAY, *Feb.* 21*st*, 1860.—Continuation pursuant to last adjournment.

GEORGE SHILLITO, of lawful age, being first duly sworn, deposes and says:

Question 1, (by attorney for defendant.) Please state your business, and how long you have followed it, and where.

Answer. My business is the manufacturing of oil, candles, and soaps. I have followed it between ten and eleven years, in Cincinnati.

Question 2, (by same.) Please state your knowledge of the mode and manner of procuring free fat acids, and the solution of glycerine from fatty or oily substances. Describe the usual mode in which this is done, whether by heat alone, or by the use of heat with chemical substances mixed with the fatty or oily substances.

252 Answer. When we first commenced, we mixed the stearine or stock with from (12 to 14) twelve to fourteen pounds of lime; we put water in, and boiled it by steam. This converted into what we call a soapy substance, a lime-soap. Then, by the use of sulphuric acid, decomposed it. We are now working under Mr. Werk's patent. Instead of using open tubs as formerly, we saponify now in close tanks.

Question 3, (by same.) What causes saponification in the presence of lime and water now; does heat or pressure; and what degree of heat do you use in your new mode?

Answer. The heat and nothing else causes saponification, and, as near as I can judge, we are using (300 to 350) three hundred to three hundred and fifty degrees of Fahrenheit. We could get up a hydraulic pressure that would destroy the tank and everything in it, without producing any saponification. The pressure would not do three works. We are now using seven pounds of lime to one hundred pounds of fat and sulphuric acid in proportion.

Question 4, (by same.) Did your ever saponify by superheated steam in an open tub, and what was the result?

Answer. We have. The result was that we produced the same stock, except the color was not as good as it ought to be. I tried it but once; attempted it the second time, but the pipes broke. The reason the color was not good was because we had not water enough, I believe. I believe that it can be done in open tubs by using superheated steam with seven pounds of lime.

Question 5, (by same.) How much lime had you in when you tried it by the use of superheated steam in open tubs?

Answer. (7) seven pounds.

Question 6, (by same.) How much does it cost you to convert (100) one hundred pounds of natural fat to fatty acid in your present mode of manufacture?

Answer. We are using (7) seven pounds of lime, which costs about three and a half cents, (17½) seventeen and a half pounds of sulphuric acid, which costs about forty-six and a half cents, making altogether about fifty cents.

Question 7, (by same.) Do you know of the new method for which Richard A. Tilghman has procured a patent? What is his process, the principle of it?

Answer. Yes. The principle, as I understand it, is to produce stearic acid by steam and water.

Question 8, (by same.) How much less would that process cost than the process you are using now, if it could be done in a reasonable time, supposing the labor to be the same in both cases?

Answer. The difference would be in the cost of lime and sulphuric acid.

253 Question 9, (by same.) State whether Mr. Tilghman's plans, if feasible, would be preferable to the plan you are using now.

Answer. It would, if it could produce the results in a reasonable time.

Question 10, (by same.) In the process you are using now, did you ever use less than seven pounds of lime? If so, what was the result?

Answer. We used (5) five pounds, and the result was not satisfactory. Five pounds, I think, was the smallest quantity we ever used.

GEORGE SHILLITO.

Cross-examination:

The further taking of depositions adjourned to Wednesday, Feb. 22d, '60, between hours stated in notice.

J. B. HORTON,
Not. Pub.

WEDNESDAY, *Feb.* 22, '60.—Continuation pursuant to adjournment.

JABEZ REYNOLDS, who, being likewise duly sworn, deposed and says:

Question (by defendant's attorney.) Please state what is your business, and where you have followed it, and how long.

Answer. I am a machinist. I have followed it in Rhode Island, Pennsylvania, and Ohio, for forty years, and have followed it for the last twenty-seven (27) years in Cincinnati.

Question 2, (by same.) Please state whether you have been engaged manufacturing machinery for the heating of fatty substances, and separating glycerine from fatty substances. If so, how long have you been furnishing such machinery? State also the different kinds of machinery you have made, and the different process followed by separating the glycerine from fatty substances in Cincinnati, at the different manufacturing establisments in Cincinnati.

Answer. I have been engaged in manufacturing machinery for the purpose stated in the question, for fifteen years at least. The first machinery we manufactured was for Verdin and Werk, manufactory on Poplar street, Cincinnati. The machinery consisted of pipes conveying steam into several vessels. In the first process, fatty substances were placed in vessels, and heated up by steam; the result of which, by the chemical combination therein placed, was a solid substance, or hard substance, called saponified materials. The second process: These hard materials were again dissolved by steam, and other chemicals added, in which condition it was passed away to cool. The next process was to bring the materials to a cold press, submit it to a given pressure, thereby separating the oily portions, to a certain extent regulated

254 by that pressure, of course. The process was to take the materials delivered from this press, and place it in another press in connection with heat, submitting it to a heavy pressure. By this process, another oily matter was separated from the material, in proportion to its pressure and heat. The residue remaining was stock from which they manufactured star candles. By the term pressure, as used above, I mean pressure by the hydraulic press. In the early commencements we used open wooden vessels, about four and a half feet deep, four and a half feet wide, and about (11) eleven feet long, lying horizontal.

The second enlargement increased the vessels to about from 12 to (14) fourteen feet long, and about (6) six feet wide and high. About the next we made, was to make the saponifying vessels round, about (12) twelve feet in diameter, still of wood, and about five feet deep. Since about that time, they have been made of various sizes and shapes, generally from twelve to sixteen feet round or square, piped with a multiplicity of small of steam. The pipes laid near the bottom. All these are open vessels. Since then I have manufactured tanks. It has been between four and five years since I first commenced manufacturing tanks for experimenting for star-candle men. One was made for Gross & Dietrich. For whom the others were, I can't say, but I think I made three. Some three years ago, I manufactured tanks for M. Werk & Co. The tank was six feet in diameter, and (12) twelve feet high, made of wrought iron. It was set up on one end. The melted material, fatty substance, was (I suppose it contained such chemicals as they wished to mix with) passed in through a pipe, through which they were filled a little more than two-thirds of the distance up. When this vessel was filled, they brought a current of steam through the boiler, through a series of pipes in a superheating oven, and from the pipes in the oven into the tank distributed again in small jets among the material in said vessel The steam left the boiler at a pressure of about ninety (90) pounds, and entered the tank at a less pressure, but carried with it a temperature of five hundred degrees (500°) and upwards, perhaps. There is an agitation in the tank driven by a distinct power, which serves to keep the whole mass in motion. The tank is weighed with a safety-valve. Whenever the pressure would rise about that weight, it would relieve itself. The weight of the safety-valve was, I think, fixed at (80) eighty pounds per square inch. I have not examined it lately to know how it is fixed now.

Question 3. (by same.) Suppose that, instead of having a safety-valve on the top of the tank, weighed as you have stated, you should let the superheated steam through a pipe one and a half inch in diameter, at a temperature of 350 Farenheit, into the bottom of the tank, and
255 leave a hole or pipe one inch in diameter in the top of the tank, for the escape of heat, what degree of pressure would there be in the tank?

Answer. I should suppose the pressure would be small over and above the weight of the material. I should suppose not over twenty (20) pounds; it might or it might not be more. I should not expect it to be more.

Question 4. (by same.) Please state when and for what other purposes you have made closed tanks, and how, and by whom, and where used. State also the manner in which substances placed in those tanks were heated?

Answer. I think it is fifteen years since I first began to work with tanks for rendering. I made them of different sizes. First, for Ebenezer Wilson, at his factory at Deer Creek, Cincinnati. Since that I have made them for the States of Ohio, Indiana, Illinois, Iowa, Missouri, Kentucky, and Pennsylvania, all for rendering lard and tallow. Those vessels were generally six (6) feet in diameter, and ten or twelve feet high, and heated by steam, introduced into the coil at the bottom of the vessel, perforated with small holes, through which the steam passed through a multiplicity of jets, into water first, and from that ascending through the material until the mass was dissolved. The safety-valve controlled the pressure, and fixed at from seventy-five to eighty pounds to the square inch. In operation, the boiler safety-valve was fixed up from

five to ten pounds greater than the tank safety-valve pressure. It was never intended in rendering that the safety-valve of the tank should be raised; therefore the boiler pressure and it were fixed near together.

Question 5, (by same.) Please state what difference there is, if any, between saponifying under the process you have described in open vessels, and in effecting the same result by the closed tanks and use of superheated steam, as to the economy in manufacturing, and as to the quantity manufactured in the same period of time?

Answer. The product of star candle stock appears the same. In the mode of handling or conveying the materials in a fluid form from one vessel to another, there must be an important saving; and in the communication of high temperature obtained through the superheated steam, directly in contact with the materials, a more rapid and perfect saponification is obtained.

Cross-examination:

Question 1, (by Mr. Tilghman.) In an open vessel, can water be heated above 212 degrees Fahrenheit?

Answer. No, sir; nor in a closed one either.

Question 2, (by same.) In a boiler working at ninety pounds
256 pressure per square inch, is the water at or over 212 degrees Fahrenheit?

Answer. I am satisfied, in my own mind, that the water in a boiler at ninety pounds pressure is but at 212 degrees temperature. I suppose at 150 pounds pressure it would be the same, or within a degree or two of it.

Question 3, (by same.) What is the temperature of steam coming from a boiler at ninety pounds pressure?

Answer. I have not the precise temperature in my mind, but the pressure is the result of an increased temperature in the steam.

JABEZ REYNOLDS.

NATHANIEL ROPES, Jr., of lawful age, also being first duly sworn, deposes and says:

Question 1, (by defendant's attorney.) Please state what is your business, and where you are following it, and how long you have followed it?

Answer. I am in the business of manufacturing star candles. I am engaged in it in Cincinnati, and have been engaged in it four or five years.

Question 2, (by same.) Please state in what way you have separated the glycerine from fatty substances, used in manufacturing star candles; that is, how much lime have you been in the habit of using in the process, and how much acid in afterwards separating the lime from the fatty substances?

Answer. We use a tub about ten feet in diameter, and eight feet high, with iron pipes at the bottom, through which the steam is conveyed; one main pipe through the center of the tub, with six or eight arms or cross-pipes; these are perforated with small holes. Into this tub we put stearine, then we use from eleven to thirteen pounds of lime to one hundred pounds of stearine. This lime we make into a mixture, called the milk of lime, by adding water to it. After this mixture of lime is thrown into the tub of stearine, the tub is covered over and weighed, and the whole mass is cooked from six to eight hours. This is called a lime-soap. This lime-soap is then thrown into another tub, into a mixture of sulphuric acid and water; there it is cooked until thoroughly dissolved. This solution of grease is a combination of stearic acid,

margaric acid, and oleic acid, which are separated from each other by means of hydraulic presses. After the lime-soap is formed, the glycerine, uniting with the water, is drawn off. The rule is to use two (2) pounds of sulphuric acid to one pound of lime.

Question 3, (by same.) Please state whether you have lately been using a new process of effecting a of glycerine from fatty substances? If yea, describe the process and machinery used.

257 Answer. We have been using a new process, introduced by Mr. Tilghman, of Philadelphia, by which he places 2,000 pounds of stearine in a copper boiler, in which there is an agitator, and mixes with it one thousand (1,000) pounds of water. There is a pressure from 150 to 155 pounds; and from sixteen to eighteen hours of cooking, the stearine is separated from its glycerine, and by these means becomes fat acid. This was placed in hydraulic presses, similar to the old mode, and the stearic acid separated from the margaric and oleic acids. The boiler is set in a furnace and heated by a fire. This is owing to our boiler not having the capacity to carry pressure over ninety (90) pounds.

Question. 4, (by same.) How long have you operated in that way? State how many different experiments you have been trying to separate glycerine from fatty substances. Have you at any time used any steam into your boiler or tank? If yea, what heat is the steam introduced into the copper boiler?

Answer. We did this twice; first, as much as I can judge, five weeks ago. We did it twice in succession, that is, two heatings. I can't give the exact number of experiments; but, since this, we have been working with the usual regularity, varying from half per cent. to two per cent. of lime—generally two batches in succession of each percentage—that when we used one half per cent. of lime, we made two batches; and when we used one or two per cent. we cooked two batches. When we first start in the mornings we raise the pressure of the tanks to the same pressure as the steam-boilers, by means of a pipe connecting the two together; after the tank has been raised to the pressure the steam from the large boilers is cut off by means of a stop-cock in tank up as before to 250 pounds by means of a fire.

Question 5, (by same.) Please state why you ceased to operate without the introducing of any lime into your stearine or fatty substance. State also how much lime you use when you produce the best result.

Answer. Owing to the length of time it took to separate the stearine into glycerine and fat acids. This is the reason why we quit attempting to cook without using lime. So far as I am personally concerned, I was better pleased with the result of two per cent. of lime than any other, up to the 20th of the present month, on which we introduced more water, and a half per cent. of lime; the fat acids of which we have not as yet pressed, but from the general appearance of the stock, I think that the result will be the best.

Question 6, (by same.) How many batches did you make with the ½ per cent. of lime on the 20th inst.? How much water did you use to a given weight of stearine? How long did it take you to make the batch?

258 Answer. We made one batch on the 20th, and one on the 21st. We used 1,500 pounds of stearine to 1,500 pounds of water, and one half per cent. of lime. I suppose it was cooking from six to eight hours, from the time the pressure was up.

Question 7, (by same.) How long was you getting the pressure up?

Answer. I don't know.

Question 8, (by same.) How long did it take you to work the two first

batches you speak of, without using any lime? State as near as you can.

Answer. It took 18 hours to cook the first batch, and from 16 to 16½ hours for the second batch.

Question 9, (by same.) How long did it take you to cook a batch in the old mode, before you began to operate under Mr. Tilghman's plan?

Answer. The first operation would be from six to seven hours, the next operation would be from 4 to 5 hours. To separate the glycerine would take from 4 to 7 hours, and then to get the lime out would take from three to five hours.

Question 10, (by same.) Please state how the free fat acids, which you say was produced in the two first batches without the *the* use of lime, compare in purity and usefulness to that produced in the old process by use of lime.

Answer. In these two batches the glycerine water thrown together with the fat acids into one tub, and there boiled up together to settle; owing to this glycerine being mixed up through the grease, I do not think that it would be right to say the stearic acid obtained from those fat acids was not of as good a quality as that we have since obtained, as I think the glycerine somewhat darkened the stearic acid, the mixture of which was solid and firm. The quality I consider as good, but the glycerine darkened the color. I don't think the free fat acids were as good as that made under the old process, owing to the glycerine being boiled up with the fat acids and thus darkened in the color.

Question 11, (by same.) Is it not important to the manufacture of star candles that the fat acids should be of a pure white color?

Answer. As a general thing the fat acids, after decomposition, are of a yellow color.

Question 12, (by same.) What color has the fat acids produced by the two batches made without lime. Was it near enough the yellow color you speak of to be considered a good, useful article?

A nswer. I should say the fat acids produced by the two batches without lime were actually lighter, but the stearic produced from this was somewhat darker, and from these two trials were not as good as that made under the old process.

259 Question 13, (by same.) Please state under whose direction was your apparatus got up; and at whose expense placed in your factory. Had Mr. Tilghman anything to do with the apparatus in conducting the process?

Answer. I can't say who got the apparatus up, or at whose expense it was got up. It was placed in our factory by Mr. C. B. Tilghman, the brother and agent of the plaintiff, and at his expense, if we are not satisfied with his process sufficiently well to purchase it. That is, if I understand the agreement. I think that is the agreement.

Question 14, (by same.) Have you and your partner yet become satisfied that Mr. Tilghman's process of separating the glycerine from fatty substance without the use of any lime can be profitably used by manufacturers? Do you now manufactnre under process solely, or are you only experimenting in the matter?

Answer. We have not yet become satisfied that Mr. Tilghman's process of separating the glycerine from fatty substances without the use of any lime can be profitably used by manufacturers. We are manufacturing daily with this tank, using from one-half to two per cent. of lime. I refuse to answer whether we are working solely in this way, because I think it is prying in my private business.

Question 15, (by same.) Please state what degree of heat you use in the copper boiler or tank. How does the copper boiler lay or stand?

Answer. I don't know the degree of heat used in the boiler or tank. The steam-*guage* indicates 150 pounds pressure to the square inch. The copper boiler stands horizontal, set in the furnace.

WM. ROPES, JR.

Adjourned until Saturday, Feb. 25th, A. D. 1860, between hours stated in notice annexed for the further taking of depositions of W. Ropes, and until shows of other witnesses, Feb. 23, for depositions.

SATURDAY, *Feb.* 25, 1860.—Continuations of depositions pursuant to adjournment.

Mr. ROPES, being recalled, deposes and says:

Question 16, (by Mr. Fox, for defendant.) Please state whether, in the process used under the direction of Mr. Tilghman, you used any acid. If so, state the quantity you use.

Answer. We use acid to decompose the stock; the same proportion of acid to the percentage of lime as used in the old process.

Cross-examination:

Question 1, (by Mr. Tilghman, for defence.) Have you been
260 making merchantable candles from the products of Mr. Tilghman's apparatus?

Answer. We have.

Question 2. In the old process is there not a waste of the fat from some of the fat acid getting intimately mixed with the large quantity of sulphate of lime produced, and being thrown out with it?

Answer. There is a certain percentage of the fat lost in that way.

Question 3, (by same.) Is not this waste less in Tilghman's process on account of the less quantity of lime produced?

Answer. I should suppose it was, but I wouldn't like to say so for a certainty. I presume it is on account of there being less lime used.

Question 4, (by same.) By the old process, with thirteen or fourteen pounds of lime and one hundred pounds of fat, how much fat acids were produced?

Answer. I have always thought ninety-five pounds of fat acids from one hundred pounds of grease, or about five per cent. waste on the original quantity of fat.

Question 5, (by same.) By Tilghman's process, with one-half pound of lime and one hundred pounds of fat, how much fat acid was produced?

Answer. According to weight of my own weighing, about (97) ninety-seven per cent. of the original weight of fat.

Question 1, (by defendant's attorney.) What causes the loss of weight in the two processes? Is it not in the separation of the glycerine from the grease; and does not the whole loss depend upon the amount of glycerine separated from the fatty substances?

Answer. According to the best authorities, there is eight per cent. or eight per cent. and a fraction of glycerine in the fat or grease that is used, but practically, by the use of lime, all the glycerine is extracted from the fat. When we come to decompose this lime-soap by the use of acid, we do not entirely extract the grease from the lime. There is always a percentage left in it which can be obtained by working it separately. This percentage is so small that it would not justify doing so.

Question 2, (by same.) If there is eight per cent. of glycerine in fatty substances, and you lose only three per cent. in weight in working by

Mr. Tilghman's process, as I understand you, there is five per cent. or five per cent. and a fraction of glycerine which is not separated from the fatty substances. Do I understand you correctly?

Answer. Well, I suppose the glycerine is extracted, and the weight must be obtained from the water, as the theory has always been
261 that fatty substances could not be crystalized until the glycerine was separated from it, or a greater portion of the glycerine.

Question 2, (by same.) Do you mean to say that the whole eight per cent. of glycerine is, in fact, separated from the grease by Mr. Tilghman's process; and that the difference in weight between ninety-two per cent. and ninety-seven per cent. is made up by a mixture of water with the grease?

Answer. I don't suppose that all the glycerine is extracted from the grease. What part is extracted I don't know. I never calculated it, and never attempted to. As to ninety-seven per cent. of fat acids I can account for in no other way, except it must be from the water and the half per cent. of lime which we use.

Question 4, (by same.) If your fat acids contain any glycerine, are they fit to use in making candles? If yea, with what amount of glycerine in the acids can you use those acids?

Answer. Well, I'll have to say that I don't know, but I have always supposed there was some glycerine in the fat acids, as one day's operation varies somewhat from the preceding day's.

N. ROPES, JR.

MONDAY, *Feb.* 23, 2 *p. m.*—Continuation pursuant to adjournment.

E. S. WAYNE, recalled, deposes and says:

Question 1, (by Mr. Tilghman, for plaintiff.) You have stated, in your answer to the 2d question, that you are acquainted with a process for manufacturing fat acids, wherein, instead of fifteen or twenty per cent. lime, only one-fourth that proportion is used, by placing the lime and fat in a close vessel, and applying either superheated steam or pressure, producing an acid lime-soap. When did you first know of this process?

Answer. I think about 1855 was the first I remember of it in Wagner, (but my impression is, that Mr. Grasselli told me of it some years before, on his return from France.)

(The part of above answer in parenthesis, objected to as hearsay.)

Question 2. Are not fat acids, whether produced by one of the processes mentioned in answer to the 2d question-in-chief, or any other of said processes, chemically the same substances?

Answer. Yes.

Question 3. You have said that fat acids are tribasic; and that in case of this acid lime-soap, it combines with an equivalent of lime and two equivalents of hydrogen. Now, suppose the lime was absent, would not the fat acid be then combined with another equivalent of hydrogen?

Answer. If there was no lime present, unquestionably.

262 Question 4. When fat acid is combined with no other base than hydrogen, is it not the same as what chemists call free fat acids?

Answer. Yes, sir.

Question 5, (by same.) Is not this hydrogen necessary to its existence as free fat acid?

Answer. Yes, sir.

Question 6, (by same.) Do not all acids, such as common sulphuric,

nitric, and muriatic acid, contain a certain amount of water, or hydrogen, or other substances, which is theoretically considered as *above* [a base?]

Answer. Yes, sir.

Question 7, (by same.) By the term acid soap, do you not mean a compound in which lime is combined with an excess of fat acid?

Answer. No. It contains hydrogen as a base, which may be replaced by other bases, such as lime or water, for instance. Sulphuric acid acts as bibasic acid, in many instances. It will combine with one equivalent of base and one equivalent of water, making a bibasic compound. So, also, phosphoric acid will form a tribasic salt or compound with water and bases.

Question 8, (by same.) Do you consider what is vulgarly and commonly called free fat acids to be combined with a base, within the sense of your last answer?

Answer. Yes.

Question 9, (by same.) In the process you have spoken of as mentioned in Wagner, what becomes of the glycerine? Is it destroyed or dissolved in water?

Answer. Dissolved in water.

Question 10, (by same.) In that process is water in a liquid state necessary to be present in the close vessel alone with the lime and fat, in order to dissolve the glycerine?

Answer. Water is necessary in the process.

Question 11, (by same.) What temperature do you understand to be used in that process?

Answer. Four hundred to four hundred and fifty degrees of Fahrenheit.

Question 12, (by same.) If that temperature be used, and water is present, is it not necessary that the vessel should be closed so as to prevent the water escaping as steam?

Answer. Under certain conditions it would be. Now, there is a very great difference in the application. In the saponification of fatty bodies by means of a small percentage of lime, a certain amount of heat is necessary to produce the decomposition. This heat may be thrown in a sulphuretted condition—steam is commonly used—this heat coming in immediate contact, will produce the decomposition
263 with much less pressure on a safety-valve than the temperature necessary to raise the heat of steam to the point mentioned—four hundred to four hundred and fifty degrees. In case superheated steam is not used, the safety-valve of the vessel would have to be loaded to a greater extent than in the other to obtain the necessary heat. I would further remark it would make no difference how the heat is applied, having water or steam present.

Question 13, (by same.) In a common steam-boiler, are not the water and the steam at the same temperature?

Answer. Sensibly, but not actually; by a thermometer they are.

Question 14, (by same.) Is not superheated steam, steam which has received an extra dose of heat out of the presence of water?

Answer. Steam is the same as a gas, and viewed as such. We call it a gaseous body. It absorbs heat, and expands by heat, the same as any other gaseous body. The laws of expansion are the same. Steam may be superheated in the presence of water. Superheated steam is a current of steam heated to an indefinite point by passing through heated coils or pipes.

Question 15, (by same.) If superheated steam, commonly so called, be impelled into water at 212° Fahr't, what effect is produced?

Answer. It would cause evaporation of it unless confined by pressure.

Question 16, (by same.) If the vessel containing the water be closed, will not the pressure therein be increased in an exact ratio to the amount of heat imparted to the water by the superheated steam?

Answer. No, sir. That is to be explained. If I pass steam through a low tension or high tension, either one from a boiler through a superheated into another vessel partially filled with water, and also closed, the latter will become heated until the temperature is somewhat superior to that of the boiler supplying the steam. The temperature will then be equalized; the temperature and the pressure both.

Question 17, (by same.) In the process above mentioned, with four per cent. of lime, is there any distillation of the fat acids?

Answer. None.

Question 18, (by same.) In the process referred to in Regnault, where the fat is distilled at a temperature of (570) degrees Fahr't, and the saponification obtained by heat alone, is there any water present in the still in a liquid state?

Answer. No, sir.

Question 19, (by same.) Is any pressure employed in that process?

Answer. The pressure is not necessary.

264 Question 20, (by same.) Is the glycerine destroyed in that process?

Answer. More or less; not entirely.

Question 21, (by same.) In Tilghman's process is any water present with the fat in a liquid state?

Answer. Water is present with the pressure used.

Question 22, (by same.) Is the glycerine destroyed or dissolved in the water?

Question 23, (by same.) Is the fat acid distilled in Tilghman's process?

Answer. No, sir.

Question 24. In your answer to the sixth question-in-chief, in that part of the answer enclosed in parenthesis, do you refer to Mr. Tilghman's process?

Answer. No, sir.

Question 25, (by same.) Referring to your answer to the 4th question-in-chief, setting aside the question of economy, could you, from your skill as a practical chemist, produce free fat acids and solution of glycerine by the process and apparatus described in Tilghman's patent?

Answer. Yes, sir; I could work it.

Question 26, (by same.) Is it your opinion, as a practical chemist, that you could economically produce free fat acids and solution of glycerine in any other form of apparatus, but by the same process as that described in Tilghman's patent, to wit: The action of water upon fats at a high temperature or pressure?

Answer. I do not think the apparatus could be modified so as to produce fat acids with economy, in an apparatus differing in the tub form of Mr. Tilghman's. That the actual contact of the elements could not be brought into such intimate chemical contact by any other form of apparatus; but fat acids could be produced in vessels of another form, but would require, probably, much longer time to produce decomposition.

E. S. WAYNE.

SATURDAY, *Feb.* 25.—Continuation.

E. S. WAYNE, being recalled, testified and said:

Question 27, (by Mr. Tilghman.) You have stated that the product of the process with water and four per cent. of lime in a close vessel with pressure, would be an acid soap. Now if six to seven per cent. of lime were used under the same circumstances, what would be the product?

Answer. It would still be an acid soap. I call all soaps (lime-soaps) acid soaps that do not contain sufficient base to saturate the three equivalents of stearic acid.

265 Question 28, (by same.) So far as the economy of the manufacture in the consumption of sulphuric acid is concerned, is not the excess of fat acid in this acid soap as profitable to the manufacturer as if it were what is commonly called free fat acids?

Answer. The acid soap is more economical than a neutral soap, as requiring less acid.

Question 29, (by same.) Can you point out in any book published prior to January 9th, 1854, an account of any process whereby fats have been converted into fat acids and the solution of glycerine by the action of water in a liquid state as a high temperature and pressure?

Answer. I have not seen, prior to that time, a published process or apparatus for accomplishing the same; but the hypothesis I have seen prior, that is, published prior to that time.

Question 30, (by same.) Can you point out in any book, published prior to January 9th, 1854, an account of any process, whereby fats have been saponified in close vessels containing water of high temperatures and pressures, by means of a quantity of lime, less than the chemical equivalent, so as to produce an acid soap?

Answer. Yes, I have, prior to January 9th, 1854. It is either in Payen or in Wagner; I can't say which. I heard of the process before I saw it published.

(The latter part objected to as hearsay, by plaintiff.)

Question 31, (by same.) At this time can you specify the book, volume, and page, where you saw this process?

Answer. No, I cannot.

Question 1. (Question by defendant's attorney.) Will you please define what is meant by free fat acids?

Answer. I mean by free fat acids, an acid fat, containing merely the elements carbon, hydrogen, and oxygen, uncombined with any metallic case.

Question 2, (by same.) In fatty substances used for making candles, please state what per cent. of glycerine is contained.

Answer. The fat bodies do not contain glycerine per se, but by the decomposition of fatty bodies into fatty acids, about ten per cent. of glycerine is produced.

Question 3, (by same.) In what way can that glycerine be separated by chemicals? Can it be separated by heat and water alone, so as to produce free fat acids? If yea, what degree of heat?

Answer. Glycerine can be separated at a low temperature, by means of mineral bodies, particularly the oxydes of the alkaline minerals, say lime, potash, soda, etc.; about fourteen per cent. of lime. Free fat acid and glycerine can also be obtained by the use of a smaller quantity

266 of lime than the one mentioned, but, as a general thing, as the quantity of *alcohol* [alkali] is reduced, an elevation of temperature is more or less necessary to produce the composition forming a lime-soap containing less base than the former, and glycerine.

Fat bodies can also be decomposed into fat acids and glycerine, by the action of water or steam at a high temperature, say 600 to 650; the elements, hydrogen and oxygen, apparently having their affinity very much weakened by the temperature, act, as it were, merely as a mechanical mixture of the gases in a nascent state, which combines with the fat bodies, free fat acids and glycerine being the result.

Question 4, (by same.) How long has it been known to chemists that free fat acids can be procured by water and heat alone as above described?

Answer. The fact has been known theoretically, I think, this last ten years; eight years to my certain knowledge, since 1852. I think the first practical operation of the kind was that of Messrs. Tilghman. I have never seen Tilghman's apparatus in practice. I think the first explanations and drawings of the apparatus, and description of the process, was in the London Pharmaceutical Journal, I think in the year 1855, and afterwards saw it in the Patent-Office Reports of the same year.

Question 5, (by same.) Suppose the inside of the boiler or tank in which the grease is contained, is heated at 650 Fahrenheit, what would be the pressure?

Answer. I should think the pressure would be about four hundred (400) pounds to the inch.

Question 6, (by same.) What is the difference between acid soap and free fat acids?

Answer. An acid soap is a fat acid containing one or two equivalents of a mineral base, such as lime, potash, etc. Fatty acids are tribasic, that is, stearic acid will combine with three equivalents of a mineral base, forming a neutral soap. If one equivalent of a mineral base be taken from it, and be replaced with either hydrogen or water, an acid soap would be the result.

Question 7, (by same.) Can you obtain a free fat acid while lime is present?

Answer. No, sir; not entirely. There would be soap formed to the extent of the lime present. The mass would contain an acid lime-soap, with free fat acids.

Question 8, (by same.) Please state what you call the product produced by heat, water, and fatty substances, at a high degree of temperature, 612°?

Answer. I call them free fat acids and glycerine.

Question 9, (by same.) What do you call the product of fatty
267 substances when the glycerine is separated by means of lime and the lime separated by sulphuric acid?

Answer. If 14 or 15 pounds of lime is used, the product would be a neutral lime-soap by (decomposition;) being decomposed with sulphuric acid, will give free fat acids and sulphate of lime.

Question 10, (by same.) Can an acid soap be converted into free fat acid without using other acids? Is there any free fat acid present in an acid soap?

Answer. An acid soap cannot be converted into free fat acid, without using other acids having a greater affinity to the base than the fat acid. There is no free fat acid present in an acid soap. In an acid soap, water or hydrogen acts as a base.

Question 11, (by same.) Please state what you call the product of fatty substances by action of water at a high temperature and pressure.

Answer. Free fat acids.

Question 12, (by same.) At what degree of heat is water decomposed into its simple elements?

Answer. I know of no degree of heat by which water is decomposed into its elements; but water at a high temperature acts differently in chemical decompositions and combinations. Its elements seem to act with greater freedom, and as elements in a nascent state. Water is decomposed by passing it in a state of vapor over heated metals, particularly iron; the iron absorbing its oxygen to a certain extent, and liberating the hydrogen.

Question 13, (by same.) What difference is there, if any, in the chemical results between the process of Mr. Tilghman and the process used by Mr. Werk, suppose the latter uses seven pounds of lime to 100 pounds of fatty substance?

Answer. By Mr. Tilghman's process I consider the following to be the result: Stearic acid in its simplest form, as mono-stearing, is composed of 35 equivalents of carbon and 34 of hydrogen, 3 equivalents of oxygen with 3 equivalents of water. This body, in its combinations, acts in a triple combination; that is, three times the number. Hydrogen and carbon, and oxygen, mentioned as mono-stearic, is always present in a lime-soap, combined with three equivalents of lime. In an acid soap, one of these equivalents of lime, or two of these may be replaced by water acting as a base. In Mr. Tilghman's process, a neutral fat acid is produced, i. e., all the three equivalents of acid in combination with water, as follows:

3 C 35 H 34 113 + 3 HO.

If seven pounds of lime are used in the producing of fat acids, a different product would be obtained, namely, stearic acid in its
268 triple form, but with this differing, two equivalents of water would be replaced by lime, as follows:

3 C 35 H 34 11 3 + HO 3 CaO.

E. S. WAYNE.

SATURDAY, *March 3rd*, 1860—2 *p. m.*

JAMES GAMBLE, being recalled, deposes and says:

Question, (by Mr. Tilghman, for plaintiff.) When you first used a tank, was the tank employed naked inside, or was it lined with any substance.

Answer. It was naked inside.

Question, (by same.) Was the inside surface and rivets at all coated or corroded?

Answer. I don't know whether the sheets were; the rivets were corroded, so that the tanks *caked* [leaked.]

Question 3. Did you afterwards put a lining *lining* in your tanks?

Answer. We did.

Question 4, (by same.) Was the lining in your tanks put in according to the plan patented by Mr. Werk, the defendant?

Answer. They were.

Question 5. Did you ever hear from Mr. Werk, the defendent, that, before he adopted the plan of lining his tanks, the rivets and steam of his tanks were coated or corroded by the action of the materials treated therein?

Answer. I don't know that I ever heard anything of the kind from Mr. Werk; I may have, but I don't recollect now. My impression was that it corroded.

JAMES GAMBLE.

At the same time and place, JABEZ REYNOLDS recalled by defendant to answer the following interrogation:

Question, (by defendant.) Please state whether you are acquainted with the plaintiff's mode or process of separating the glycerine from fatty substances by means of a high temperature and pressure. If yea, state your opinion as to the practicability of manufacturing free fat acids by high temperature and pressure. What would be the pressure in the tank or vessel heated to a temperature sufficiently high to melt lead?

Answer. I examined Mr. Tilghman's patent some years ago. It purports the separation of glycerine from fatty substances by the aid of water in a high temperature and pressure. The apparatus, as patented, was limited to small quantities, and has to be operated by power through the aid of pumps, consequently limited to small quantities, con-
269 sequently requiring large expenses in proportion to the quantity separated, which, in my opinion, defeats its practicability. The pressure in the tank or vessel, heated to a temperature sufficient to melt lead, would be, I think, about 800 pounds to the square inch in the presence of water.

Question, (by same.) Do you think an apparatus of sufficient size to contain from eleven to thirteen thousand pounds of water and fatty bodies, heated to a temperature to melt *melt* lead, can be built strong enough to resist a pressure of eight hundred (800) pounds to the square inch? If yea, how and in what way, and of what materials?

Answer. I suppose a vessel might be made to bear such a pressure. In my opinion it would not be practicable. If such a thing were attempted, a variety of materials would have to be combined, and the liabilities of decay, other want of density for a continuous time would result disastrously. The materials would probably be copper or wrought iron. By continuous or actions they would lose their tenacities, and would ultimately give away.

Question, (by defendant.) Which, in your opinion, is the most practical way of getting the required heat sufficient to melt lead; whether by fire heat applied to a copper boiler or tank, or by the introduction of superheated steam into the bottom of the boiler or tank?

Answer. By the application of fire directly to a vessel filled with fluid when the temperature is so increased as to approach the point of melted lead, or 600 degrees Fahrenheit of temperature, tenacity or strength of the metal becomes weakened by the high temperature, therefore, in my opinion, if this temperature is obtained by superheating, apart from said vessels, and introduced with said temperature into the fluids contained in a vessel, the result will be much safer, more perfect, and more rapid in its operations.

Cross-examination:

Question 1, (by Mr. Tilghman, for plaintiff.) When you use the terms practicability and practicable in answer to the first and second question do you refer merely to the economical pecuniary result?

Answer. When I use the term "practicability" in reference to the small vessel in my answer to the first question, it applies to the economical expenditures in preparing or changing the materials in said vessel; or, in other words, to the economy of manufacture. What I mean by saying "practicable" in the second proposition, referring to the large vessel in answer to the second question-in-chief, is, that with a large vessel, and a large mass of material, and under the enormous pressure

270 required, would be subject to so many mishaps that the use of it would be defeated.

JABEZ REYNOLDS.

The above depositions were taken in the presence of the parties, at their convenience, and are to be used as evidence on the hearing of the cause mentioned in the caption, so far as competent, and all primal objections as to the time and manner of taking the same are waived.

CHARLES FOX, *Attorney for Def't.*
B. C. TILGHMAN, *Agent for Pl'tiff.*

MARCH 3, 1860.

271 TESTIMONY.

TILGHMAN *vs.* M. WERK.

Witnesses for defendant recalled.

At the time and place above named appeared the said EUGENE GRASSELLI, who was sworn in the cause above named, and deposed and said:

Question 1. Please state your business. State also whether there is any such thing as an acid soap known among chemists. If yea, state what it is, and in what books the term is used.

Answer. I am a manufacturing and an analytical chemist. An acid soap is a thing known among chemists. An acid soap is a bistearate, bimargarate, and bioleate of lime. The same of potassa and of soda are known, and these terms are found in Wagner's Yearly Report, and in Payen's new edition of his chemical work of 1859, and in numerous other chemical works.

Question 2. State whether, by the process of Mr. Werk, using 7 pounds of lime to 100 pounds of fat, and 130 pounds of water, any free fat acid is produced. If yea, is it separated from the lime-soap, or does the substance he produces have to undergo any other, and what, process to separate the fat acid so as to make it a free fat acid fit to use as such?

Answer. There is no free fat acid produced, but an acid lime-soap, or bistearate, bimargarate, and bioleate of lime. The substance he produces has to undergo another process, to obtain the free fat acid. This process consists in neutralizing or decomposing the acid lime-soap, by diluted sulphuric acid.

Question 3. Suppose you submit lime-soap to a high temperature of water under pressure, what will be the result? What will be the result, if you add fat to the lime-soap, and submit to same temperature and pressure?

Answer. No result at all. You had just as well subject a piece
272 of cast iron to pressure for 24 hours. When fat is added to it, and subjected to a high temperature and pressure, the lime of the neutral soap obtains the property of combining with another equivalent of fat acids, and will thus be changed to an acid lime-soap, or bistearate, bimargarate, and bioleate of lime.

Cross-examination by Mr. Harding, for the plaintiff:

Question 1. Please define the term soap.

Answer. The term soap is a neutral compound, or stearate, margarate,

and oleate of potassa or of soda. If potassa is used, a soft soap is produced, and if soda, a harder one. Likewise, at the ordinary temperature of boiling water, a neutral lime-soap can be obtained, the bases above named separating the glycerine from the fatty matter employed. If a new quantity of fatty matter is added to either of the above soaps, and is heated by superheated steam in the presence of water in a close vessel, acid soaps are obtained.

Question 2. Has the superheated steam any other effect than to heat the water in the tank, without burning the fat, as a direct application of fire to the tank might do?

Answer. Lead can be melted by superheated water, in a machine of Papin. The same can be done by superheated steam. The difference lies only in the machines used for it. In the first case the water has no room to form steam.

Question 3. Question repeated.

Answer. The superheated steam has no other effect, but you don't run the risk of burning your boiler underneath, as you would by the direct application of fire.

Question 4. What experiment have you tried, in order to enable you to say that highly-heated water will not decompose lime-soap?

Answer. Because it is impossible. It is nonsense. You might just as well make an S [Yes] out of an O [No.]

Question 5. Question repeated.

Answer. No, sir; I would not waste my time in making such experiments.

273 Question 6. Are you certain that highly-heated water under pressure has no effect whatsoever on lime-soap?

Answer. Yes, sir.

Question 7. The highly-heated water under pressure has no more effect on the lime-soap within the boiler, than the highly-heated water has upon the boiler itself?

Answer. No, it has no more effect. You may burn the boiler, water, lime-soap, and everything else up, without decomposing it.

Question 8. Why is it that highly-heated water will not decompose lime-soap?

Answer. Lime-soap cannot be decomposed, or any other soap, unless a strong acid is used to combine with the base or the alkalis.

Question 9. Is this true of all lime-soaps?

Answer. Yes, sir.

Question 10. What effect has alcohol on lime-soap?

Answer. Alcohol has no effect on neutral lime-soap; but it will free the acid soap from the second equivalent of fat acids, in the same way as we can deprive bisulp'ate of potassa of its second equivalent of sulphuric acid by distillation.

Question 11. Suppose I was to mix lime-soap with free fat acid, by merely heating the fat acid, and diffusing through it melted lime-soap, and I wished, after this union had been made, to separate the free fat acid so mixed, without in any way affecting the *the* lime-soap, so as to obtain again the free fat acid unchanged; how would you advise me to do it?

Answer. Well, you could do it by alcohol.

Question 12. Why would you, in the case inquired of, employ alcohol, and not sulphuric acid, or some other acid?

Answer. Because it was only desired to separate the fat acids when mixed with a neutral soap. Otherwise I would use muriatic or sulphuric acid to decompose the neutral soap, thus rendering the use of alcohol unnecessary.

Question 13. The amount of sulphuric acid which you would use in such case, would be the precise amount proper to combine with the lime in the neutral soap, and form a sulphate of lime; would it not?

Answer. Yes, sir; just so.

274 Question 14. The rationale of the process might be thus stated, might it not? Given a mixture of lime-soap and free fat acid; if you wished to separate the free fat acid alone, use alcohol, and it will remove the free fat acid, and leave the lime-soap untouched. If you wish to obtain the free fat acid, as well as the fat acid which was combined with the lime chemically, use a quantity of sulphuric acid sufficient to combine with that lime in the lime-soap, and it will unite with the lime in the lime-soap, forming sulphate of lime, and you will thus obtain the free fat acid which was not combined chemically, as well as that which was released from its chemical combination with the lime in forming the lime-soap?

Answer. Yes, that is correct.

Question 15. So far as the free fat acid is concerned, which was not combined chemically to form the lime-soap, the sulphuric acid performed no chemical action whatever?

Answer. No.

Question 16. What chemical experiment did you try, to enable you to determine what is the precise effect of highly-heated water under pressure upon fatty bodies?

Answer. I have not tried any experiment, but I have read the chemical works I have named, and understand the process perfectly. Furthermore, I have seen the process at George Shillito & Co.'s factory.

Question 17. How much lime do they use at their factory?

Answer. About seven per cent. of lime; about half the quantity formerly used. In France they use even less, as I learn from French, German, and English works.

Question 18. Please explain how you are enabled to tell, from inspecting Geo. Shillito & Co.'s works, where they use seven per cent. of lime, what the effect of highly-heated water under pressure would be on fatty bodies without the use of lime?

Answer. If you boil fat for several days without the use of lime, you might obtain some free fatty acids from it.

Question 19. How do you know you might?

Answer. Because the quantity of fats thus heated in a tank of the capacity of that at Shilito's factory, would not be a fit vessel to

275 obtain the free fatty acids, after the manner of Mr. Tilghman's patent, where an emulsion of fats and water are forced through a series of wrought-iron tubes or pipes, exposed to a high temperature. It would be, in my opinion, a losing business to try to obtain free fat acids in that manner at Mr. Shillito's factory.

Question 20. Can you give no other reason for your statements as to the action of highly-heated water on fatty bodies, than what you have given? I mean, have you experimentally any knowledge whatever of the action of highly-heated water on fatty bodies?

Answer. You can find as much as you please in every chemical work on the subject. I have not experimented on the subject, but I am perfectly informed on the subject.

Question 21. Please state by what experiment you ascertain that in Mr. Werk's process an acid lime-soap was produced, or, as you have termed it, a bistearate, a bimargarate, and bioleate of lime?

Answer. I have read of it in several chemical works. I am perfectly satisfied from my knowledge of the matter that the terms so used for

this new product are correct and true. I have not learned it by my own experiment, but I have seen it practically on a large scale in Messrs. Shillito & Co.'s factory.

Question 22. Did you ever analyse the product of Mr. Werk's process, or the product of Mr. Shillito's ?

Answer. I have never been requested to do so, else I would have done it with pleasure.

Question 23. As your knowledge of the chemical composition of Mr. Werk's product is derived by you solely from chemical books, will you now please produce the book or books, and read to the commissioner the precise passage which states that the product of Werk's process is an acid lime-soap, or, as you have called it, a bistearate, bimargarate, and bioleate of lime. I wish you, in answering this question, to point out specifically where the term "acid lime-soap" is used, and where the terms "bistearate, bimargarate, and bioleate of lime" is used.

Answer. I have not the books here, and can not do it; besides, I have not the time; I cannot spare it from my business.

(The counsel for the planitiff here hands the witness Payen's Chemie Industrielle, and other chemical works.)

276 The witness cites Regnault's Chemistry, vol. 2, page 691: "The acid forms two salts with potassa: bipotassic stearate, 2. KO. C_{68}. H_{66}. O_5." Also Dr. Herman Kolbe's Organic Chemistry, ed. 1859, vol. 1, p. 997: "The acid stearate of soda, NaO. C_{36} H_{35}+HO. C_{36} H_{35} O_3 treated in the stated manner by precipitation of the hot-water solution of the neutral salt, with 200 or 300 parts of water, gives, after drying, a white, tasteless and odorless powder, insoluble in water, very soluble in alcohol. The alcoholic solution reddens litmus paper." Same work, p. 965: "Acid stearate of potassa, KO. C_{36}. H_{35}.O^3. + HO.C_{36}. H_{35}. O_3." Here mention is made of acid stearate of potassa.

Question 24. You have now examined Payen, Regnault, and Kolbe's Chemistry, with the view to find the term "acid lime-soap." Did you find in either of these books the term "acid lime-soap ?"

Answer. No, sir.

Question 25. I now understand you to say that the term "acid lime-soap" is found in Wagner's Yearly Report, and that you think it is in the vol. for 1855, and that if an adjournment is had, you will endeavor to produce the book ?

Answer. Yes, sir.

Question 26. Did you find in Payen, Kolbe, or Regnault's Chemistry the terms bistearate of lime, bimargarate of lime, and bioleate of lime? Please answer specifically.

Answer. No. I did not find them there, but I am sure they are in Wagner's work, and I will endeavor to produce the book.

Question 27. After the adjournment, please produce any and every book which you have or can find, in which the term "acid lime-soap" is used, or the term "bistearate, bimargarate, and bioleate of lime" is used.

Mr. Harding gives notice to the defendant's counsel to produce before the commissioner, for his inspection, any and every chemical book on which they rely for the use of such terms, "acid lime-soap," or "bistearate, bimargarate, and bioleate of lime."

This examination is now adjourned to 3 o'clock, p. m. of this day, to enable the witness to produce the works called for.

A. R. DUTTON,
U. S. Commissioner.

277 On Thursday, the 25th October, the foregoing examination was resumed, and the witness was requested to answer question No. 27.

Answer. I cannot produce any book in which the term bistearate of lime is used, or bimargarate, or bioleate of lime. But acid lime-soap or acid stearate of lime is understood as bistearate of lime by every chemist. I find the term "acid lime-soap" in Wagner's Yearly Report for 1855, vol. I, p. 404.

Question 28. Please take your pencil and draw a line under the term acid lime soap in Wagner.

Answer. I have done so on page 404.

Question 29. Please examine the extract in the Chemical Gazette of 1856, page 28, in the following words: "We may suppose that the saponification of tallow by means of only four per cent. of its weight of lime, presents several distinct phases, in which a basic or neutral soap is first formed and afterward changed into an acid soap." Is that a correct translation of the passage in Wagner?

Answer. Yes, sir.

Question 30. Have you ever seen a substance which you know, from chemical analysis, to be an acid lime-soap, or a bistearate, bimargarate, and bioleate of lime?

Answer. I don't want to answer that question, the way it is put there.

Question 31. Do you assert, as a chemist, that acid lime-soap, or bistearate, bimargarate, and bioleate of lime are substances well known and recognized by chemical authorities?

Answer. Yes, sir.

Question 32. Name the chemical authorities?

Answer. I don't remember the name of the books in which I have read it. I believe it is mentioned in Dumas' Chemistry.

Question 33. Can you produce the book, and point out the place?

Answer. I will bring the five volumes of the book here, and, if I can, point out the place.

Re-examination:

278 Question 1. In order to separate the free fat acid, or any portion of free fat acid from Mr. Werk's product by alcohol, what quantity of alcohol is required for any given quantity of free fat acid obtained?

Answer. in making such analysis an excess of alcohol is generally used.

Question 2. Please state whether fatty substances can be distilled, and undergo any, and if any what, change previous to the fat being changed to a free fat acid; (that is) will distillation of fatty substances produce a free fat acid?

Answer. If the fat have previously been saponified by sulphuric acid, they might then be distilled by superheated steam.

Question 3. Can the free fat acids produced by Mr. Tilghman's process be distilled?

Answer. Yes, sir; provided no lime has been used in the saponification.

Question 4. Can the free fat acid by Mr. Regnault's process be distilled?

Answer. Yes, sir.

Cross-examination:

Question 1. How much lime, introduced into Mr. Tilghman's tank, along with his highly-heated water under pressure, and the fatty bodies,

would, in your opinion, render the process a different one from Mr Tilghman's?

Answer. My opinion is, that one half of one per cent. of lime will have a great influence in shortening the time of production of fatty acids, as a small percentage of lime will have to be eliminated or removed by diluted sulphuric acid, to change the whole product to free fatty acids.

Such a use of lime, in the above proportion, would, in my opinion, change it from Mr. Tilghman's process.

Re-examination:

Question 1. What do you call the product produced by the use of lime, as mentioned in the last answer, if a small quantity of lime is used?

279 Answer. With that half per cent. of lime I call it an acid lime-soap with a great excess of fatty acids.

Cross-examination:

Question 1. Would you call that excess of fatty acids "free fatty acids?"

Answer. No, sir.

E. GRASSELLI.

The witness, E. GRASSELLI, returns, and, in further answer to question 33, says:

I have found, in Dumas, bistearate of potassa and bistearate of soda; also stearate of lime. It now occurs to my mind that the bistearate of lime, which is only produced by the action of superheated steam on stearate of lime in presence of fatty bodies, was not known at the time of the edition of Dumas's Chemistry of 1835.

Question, (by plaintiff's counsel.) You can produce no book, then, in which the term "bistearate of lime" is used?

Answer. Not at present.

Question, (by same.) Would not what you call the bistearate of lime be produced if highly-heated water under presure was used in connection with fatty bodies and a small percentage of lime, whether superheated steam was employed as the means of heating the water, or whether it was heated by fire underneath the tank?

Answer. Yes, sir.

Question, (by same.) Then superheated steam is not essential to the production of bistearate of lime?

Answer. It is essential so far that it simplifies the process.

Question, (by same.) But not otherwise essential?

Answer. No.

E. GRASSELLI.

At the same time and place appeared also EDWARD S. WAYNE, who was sworn in the cause and deposed as follows:

Question 1, (by defendant's counsel.) Please state your busi-

280 ness. State also whether there is any such thing as an acid soap known among chemists. If yea, state what it is, and in what works the term is used.

Answer. I am a chemist. Acid soap is a term that is used in most chemical works. Acid soap contains two equivalents of stearic acid, one of an alkali, and one of water, which equivalent of water may be replaced by an equivalent of base, thereby producing a neutral soap. The

term may be found in Kolbe's Organic Chemistry, and in Lowrie's Chemistry, and in Kane's Chemistry, and in a number of other works the term is mentioned. It is a general term. Pelouze also mentions it.

Question 2. State whether, by the process of Mr. Werk, using 7 pounds of lime to 100 pounds of fat and 130 pounds of water, any free fat acid is produced. If yea, is it separated from the lime-soap, or does the substance he produces undergo any other, and what, process to separare the fat acid, so as to make it a free fat acid fit to use as such?

Answer. I do not think there is any free fat acid produced by Mr. Werk's process. The substance he produces must be decomposed by sulphuric acid so as to make a free fat acid.

Question 3. Suppose you submit lime-soap to a high temperature of water under pressure, what will be the result? What will be the result if you add fat to the lime-soap and submit to same temperature and pressure?

Answer. I do not think any decomposition, under the circumstances, will take place. I do not think any saponification will take place in either case. There will be no decomposition of the lime-soap.

Question 4. Please state your opinion as to whether the glycerine is destroyed in the process as used by Werk, and as used by manufacturers prior to his patent, in making free fat acids, or whether it can be saved or gathered after its separation.

Answer. By those who use the lime process the glycerine is not destroyed. By the process used by manufacturers, prior to Werk's patent, using the distilling process by superheated steam, the glycerine was destroyed; and those who decompose the fat by sulphuric acid destroyed the glycerine also. By Werk's process and by the old lime process the glycerine could be gathered and saved after its separation.

281 Question 5. State whether the patent of Motard & Milly, in Roret's Encyclopædia, and the one described, in same page, from the Repertory of Patent Inventions, glycerine is necessarily lost in both or either of these processes.

Answer. It is not lost in Motard & Milly's process, nor in the one described in the Repertory of Inventions.

Question 6. Please state whether any free fat acid is produced by Mr. Werk in his process, using 7 pounds of lime to 100 pounds of fat and 130 pounds of water, so that it is in a marketable condition, or fit to use as a free fat acid, without undergoing a decomposition process by the application of sulphuric acid.

Answer. It is not in a marketable condition as fat acids. It cannot be manufactured into candles without decomposing it, so as to produce free fat acids.

Cross-examined by Mr. Harding:

Question 1. Suppose you were handed a substance supposed to be a mixture of free fat acid and neutral lime-soap, in which these two substances were merely mechanically combined by melting, and you were requested to verify the fact that this substance was so composed; as a chemist, how would you proceed to do it?

Answer. I should act upon them by some known solvent of fat acids, in which the lime-soap in known to be insoluble, as alcohol, benzole, or naptha, which would dissolve the fat acids to the exclusion of the lime-soap. But the substances, the apparent mixture of fat acids and lime-soap, may be a chemical compound of loose affinity, and it would be fair to presume that I found this mixture to be composed of lime-soap

and hydrated stearic acid, to form an acid soap which the action of the solvents might themselves have decomposed.

Question 2. (The presumption of the witness is objected to, and the question is repeated.)

Answer. I could verify the fact that the mixture was composed of fat acids and neutral lime-soap, and I would be enabled to do so by dissolving the fat acids by means of alcohol or benzole.

Question 3. In thus acting, would you not have the sanction of chemical authorities as far as you are acquainted?

282 Answer. I would.

Question 4. Suppose, on evaporating the alcohol, you found the residue was fifty per cent. of the original substance submitted to you for investigation and treated by alcohol, would you not be induced to conclude that the original substance submitted to you was composed of about fifty per cent. of free fat acids and about fifty per cent. of neutral lime-soap?

Answer. Yes, sir.

Question 5. Suppose that you were to have treated the original substance with sulphuric acid, instead of alcohol, in the proportion of 17 per cent. of the whole mass, would not that sulphuric acid unite with the lime of the lime-soap and form a sulphate of lime, and would you not thus obtain by such liberation the free fat acid chemically released from its combination with the lime-soap, and at the same the free fat acid which was merely mechanically mingled with the lime-soap?

Answer. That is assuming a fact that I have not admitted. Supposing the mass to have been composed as mentioned in the former question, then the action as stated in this question would take place.

Question 6. Would the sulphuric acid in such case, chemically speaking, have any effect on the free fat acid which was not combined with the lime in the formation of the lime-soap?

Answer. Not if the sulphuric acid was used in a dilute state, as it is ordinarily employed in the manufacture of fat acid.

Question 7. Is the term "acid lime-soap" specifically employed in Kane, Regnault, Payen, Kolbe, or either of the standard chemical treatises to which you have referred?

Answer. It is not mentioned in either of these, but it is mentioned in Pelouze.

Question 8. What is the publication of Pelouze to which you refer?

Answer. It is the London Chemical Gazette, a chemical newspaper, of 1856, in which paper is copied an extract from a French journal, of December, 1855, which purports to have been written by Pelouze.

Question 9. Please read the particular sentence in which the acid lime-soap is mentioned in the extract.

283 Answer. "Acid lime-soap" is not mentioned, but an acid soap and a very basic soap is mentioned. I cannot refer to any one sentence, but I refer to the whole article from Pelouze in the paper.

Question 10. Have you any other chemical reference which you can give me except Pelouze, where the term "acid soap" is used in direct connection with a lime-soap, as distinguished from a neutral lime-soap?

Answer. I cannot.

Question 11. What experiment have you tried, to enable you to say that the product of Mr. Werk's process is, chemically speaking, an acid lime-soap, and not a mere mixture of free fat acid and neutral lime-soap?

Answer. I have made none, but base my opinion upon my general knowledge of the substances and their relations with other bodies.

Question 12. What experiment have you tried, to enable you to ascer-

tain what is the effect of highly-heated water under pressure upon fatty bodies?

Answer. I have made no direct experiments myself, but have advised and controlled others in their operations.

Question 12½. Does any person who has acted under your advice or control now use, or at any time past have they used, highly-heated water under pressure to decompose fatty bodies?

Answer. Not alone.

Question 13. Have they used highly-heated water under pressure for this purpose of decomposing fat in any way?

Answer. It has been used to facilitate the decomposition of fatty bodies with a smaller percentage of lime than was necessary to neutralize the whole amount of fatty acid present.

Question 14. By whom?

Answer. By Cheever, and by Heiatt and Woods of this city, and by Mr. Werk, the defendant.

Question 15. Is your knowledge of the action of highly-heated water on fatty bodies derived from these operations, so far as it is an experimental knowledge?

Answer. No, sir; not altogether.

284 Question 16. State what other experimental knowledge you have of the action of highly-heated water under pressure upon fatty bodies?

Answer. I have no experimental knowledge further of those matters; but have been a long time acquainted with those matters, scientifically, that is, from books.

Question 17. Can you, as a chemist, swear that the resulting product of Mr. Werk's process is certainly not a mixture of fat and neutral lime-soap?

Answer. I would not swear as a positive fact that the product of Mr. Werk's process is not a mixture of free fat acid and neutral lime-soap; but I cannot, from a general knowledge of those substances, reconcile my mind to say that it is.

Question 18. Do you think, if the lime were to be omitted from Mr. Werk's process, there would be any production of free fat acid and solution of glycerine from the action of the highly-heated water under pressure?

Answer. Free fat acid and a solution of glycerine might possibly be produced, but it would be in a small quantity. I might further say that it would not produce these substances in a practical manufacturing scale.

Question 19. Having never tried any experiment yourself, upon the power of highly-heated water under pressure alone in decomposing fatty bodies, what grounds have you for your assertion as to the practicability of obtaining, on a large scale, free fat acids and glycerine, as mentioned in the last answer?

Answer. My grounds are, works treating upon the matter, and I saw the experiments being performed at Messrs. Ropes' factory. I saw experiments tried at Ropes', and heard the results from Mr. N. Ropes, jr. He told me that, after 20 hours working by fat and water alone at a high temperature under pressure, a fat acid suitable for manufacturing candles was not produced. Now, I don't say that by the continuation of that process longer, merchantable fat acids might not be produced. The length of time would be a matter of experiment, so far as I am concerned, but I think the time required to produce it would render the process somewhat impracticable as a manufacturing process.

285 Question 20. Can you refer me to the book on which you ground your opinion?

Answer. I wish to modify my answer to question 18. I base my opinion upon the experiments at Ropes', and upon a general knowledge of the decomposing influence of water at varying temperatures upon various bodies, the temperature controlling the decomposition. I have no book authority to the special point, but from general principles I have. By the special point, I mean the practicability and economy of Mr. Tilghman's process on a large scale.

Question 21. Supposing that highly-heated water under pressure would decompose fatty bodies into fatty acids and glycerine, can you state positively that the presence of a small proportion of lime would prevent that action taking place?

Answer. It would not prevent that action taking place.

Question 22. For what purpose, and when, did Mr. Cheever and Messrs. Hyatt and Wood consult you?

Answer. In reference to the economy of using water and lime in less per cent. than would fully saturate the fat acids, the water being heated and under pressure. They have consulted me at various times. About four years ago for the first, by Mr. Cheever, and about a year ago by Mr. Woods.

Question 23. Did you give it as your opinion that such a process as they now use would avoid Tilghman's patent?

Answer. I never gave it as my opinion, for I did not think that the two processes were parallel.

Question 24. Are you certain that the reduction of the lime required in the process of Mr. Werk, and the others named by you, is not owing to the chemical power of the highly-heated water under pressure, which is present in their processes?

Answer. I am certain that the reduction of the lime is not due to the chemical power of the highly-heated water in decomposing the fatty bodies.

Question 25. Why are you certain?

Answer. My impression is, that in the first instance there is a highly basic lime-soap formed, which is decomposed by the action of water or steam at high temperatures, a mutual decomposition and recom-
286 position of that lime-soap taking place, until a perfect saponification or acidification of the fat takes place through the whole mass, and the resulting fat acids may be, as I judge, an acid lime-soap, or neutral lime-soap and free fat acid. And the chemical action of the water is to the greatest extent exerted in decomposing the lime-soap as mentioned, and not upon the fat. Now, it is well known that the elements of water must be taken up by the fat bodies to convert them into fat acids and glycerine, which takes place in either case, with lime or without lime. And the rapidity with which fat bodies can be converted into fat acids and glycerine, by the process of Werk and others, show conclusively that the saponification is due to the lime and not to the water. In an experiment made by Mr. Cheever, by using seven pounds of lime with highly-heated water, under a pressure of 350 pounds to the inch, perfect saponification resulted in half an hour. If, as mentioned, fifty per cent. of Mr. Werk's free fat acid is produced by lime, and the other half by the action of heated water, judging from the experiments of Cheever and at Ropes', the use of lime certainly exalts the chemical decomposition.

Question 26. In your explanation of Mr. Werk's process and its principles do you not imply or suppose that the lime-soap is decomposed by the action of the highly-heated water under pressure?

Answer. I have previously stated that lime-soap could not be decom-

posed by water; but lime-soap, in a nascent state, may obey the law of many other bodies, and be decomposed under the circumstances.

Question 27. Question repeated.

Answer. I presume that it is; but I don't say that the basic soap formed is the same basic soap as mentioned in the works, as fat acids form higher compounds with bases—lead, for instance—than those of lime-soaps described, and may form in this case a more basic compound.

Question 28. Do you mean to say that there are two kinds of lime-soap one of which is a nascent lime-soap, and one a common lime-soap; and, if so, what is your chemical authority for the term, nascent lime-soap?

Answer. I conceive such to exist, but their stability is slight.
287 They may be formed in the vessel, to which we have not introvision, and decomposed as rapidly as formed. I also base my opinion upon the remarks of Pelouze, and as affording an empirical hypothesis of the process involved.

Question 29. Please produce the passage in Pelouze, where he uses the term "nascent lime-soap."

Answer. That term is not used in Pelouze.

Question 30. What percentage of lime, introduced into Mr. Tilghman's process, would, in your opinion, make the operation cease to be parallel with his process?

Answer. I think any quantity of lime introduced with Mr. Tilghman's process would make the operation cease to be parallel with his process.

E. S. WAYNE.

On Thursday, the 25th of October, 1860, the above witness, E. S. WAYNE, re-appeared, and was re-examined by defendant's counsel as follows:

Question 1. In order to separate free fat acids, or any portion of free fat acid, from Mr. Werk's product, by alcohol, what quantity of alcohol is required for any given quantity of free fat acid obtained?

Answer. That is a question that I cannot definitely answer. If I should answer it, it would be a guess. I should suppose, though, that the alcohol, at the boiling point, would take up from ten to fifteen per cent. of its weight in fatty acids in solution, which would again be deposited on the cooling of the alcohol.

Question 2. Please state whether fatty substances can be distilled and undergo any, and if any, what change previous to the fat being changed to a free fat acid; that is, will distillation of fatty substances produce a free fat acid?

Answer. The action of heat upon fatty bodies depends entirely upon the temperature and the duration of the experiment. A red heat would decompose them into carbonetted hydrogen gasses. Fats placed in a vessel suitable for distillation and submitted to a gradual heating, will be decomposed into acrolein and into acids lower in the series than stearic acid. A trace of stearic acid might also be obtained—the stearic acid
288 might also be obtained—the stearic acid losing both carbon and hydrogen by the decomposing influence of the heat, thus forming other acids and an oily body as a product of the decomposition. Free acids will be produced, but not stearic acid—perhaps only a trace.

(By plaintiff's counsel.) In Mr. Werk's process is highly heated water under pressure present?

Answer. There is, most unquestionably, a portion of water present. There must be, from the arrangement of his apparatus. That water

must be highly heated and under pressure. The heat of the water is in proportion to the pressure.

I wish here to correct an error in my statement yesterday. In referring to Mr. Cheever's experiments, I should have said 350° of temperature, instead of 350 pounds of pressure.

E. S. WAYNE.

289 Circuit court of the United States in and for the southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN Kirby, and M. Schwartz. } In equity.

To the honorable the judges of the circuit court of the United States in and for the southern district of Ohio:

Richard A. Tilghman, of Philadelphia, in the State of Pennsylvania, and a citizen of said State, brings this bill against Michael Werk, Thomas Kirby, John Kirby, and M. Schwartz, of Cincinnati, in the State of Ohio, and citizens of the southern district thereof.

And thereupon your orator complains and says that on or before the ninth day of January, 1854, one Richard A. Tilghman was the true original, and first inventor of a certain new and useful improvement in processes for purifying fatty bodies, not known or used before, and not, at the time of his application for a patent, in public use or on sale with his consent or allowance.

290 And your orator further shows to your honors that the said Richard A. Tilghman, so being the inventor of said improvement, and being a citizen of the United States aforesaid, made application to the proper Department of the Government of the United States for letters-patent, in accordance with the then existing laws of Congress; and, having duly complied in all respects with the conditions and requisitions of said laws, on the third day of October, 1854, letters-patent of the United States, signed, sealed, and executed in due form of law, for his invention or discovery, were issued to the aforesaid Richard A. Tilghman, whereby there were secured to him, his heirs, executors, administrators, and assigns, for the term of fourteen years, from the ninth day of January, 1854, the full and exclusive right of making, using, and vending to others to be used, the said improvement.

And your orator further shows that a description or specification of the aforesaid improvement was given in the schedule to the said last-mentioned letters-patent annexed, accompanied by certain drawings referred to in said last-mentioned schedule and forming part of said last-mentioned letters-patent. That the said last-mentioned letters-patent and the said specification thereto annexed (which, or an exemplified copy of which, your orator will produce, as your honors may direct) were duly recorded in the Patent-Office, a copy of which is hereto annexed, marked "A."

And your orator further shows that, afterwards, to wit, on or about the 15th day of March, 1867, the said Richard A. Tilghman made application in writing to the Commissioner of Patents, praying for an extension of the said last-mentioned letters-patent, having complied in all respects with the then existing laws of Congress; and, on the 23d day of November, 1867, the Commissioner of Patents did decide the said patent ought to be extended, and did, on the day last mentioned, renew and extend

said patent, by certificate thereon endorsed, for the term of seven years from the 9th day of January, 1868, as by the said certificate or a duly authenticated copy thereof in court to be produced, as your honor
291 may direct, reference being thereto had, will appear, and a copy whereof is hereto annexed, marked "B."

And your orator further shows that a suit in equity was commenced in the circuit court of the United States for the southern district of Ohio, by your orator, against Michael Werk, of Cincinnati, one of the defendants above named, for an infringement of said letters-patent.

That said suit came to a final hearing at the session of said court, holden at Cincinnati, November, 1860, on bill, answer, and proof, and, being fully argued by counsel, it was, on the 26th day of April, 1862, ordered, adjudged, and decreed that the said Richard A. Tilghman was the original inventor of the invention patented to him, and that the said letters-patent were valid; and that said Michael Werk, the defendant, had disturbed, violated, and infringed upon the complainant, the said Richard A. Tilghman, in his exclusive rights, as in the said bill set forth.

And it was further ordered, adjudged, and decreed that the complainant recover of the defendant the profits and gains by him made and received in consequence of the said infringement.

And that it be referred to Charles B. Collier, esq., as master, to compute and ascertain the damages which the complainant was entitled to recover of the defendant.

And it was further ordered that the defendant be enjoined from manufacturing free fat acids by the process secured to the plaintiff by his said patent, as set forth in his said bill of complaint: Provided, however, that this injunction shall not prevent the defendant from using his close tank for manufacturing; not infringing plaintiff's patent, as the exclusive use of a close tank, is not in the opinion of the court, a part of the plaintiff's rights secured by his patent. Copies of which decree, and of the opinion of the court in said suit, are hereto annexed, marked "C" and "D."

292 And your orator further shows that, afterwards, on or about the 2d March, 1865, and while the said decree of injunction against said defendant was in full force and operation, upon the affidavit of the complainant that said Michael Werk, the defendant, had been and was then manufacturing free fat acids by the process patented to the complainant, in violation of his exclusive rights, and in disobedience and contempt of the decree of injunction, the said court ordered Charles B. Collier, esq., the special master, to examine said defendant's apparatus and mode of working, and to ascertain with what percentage of lime defendant was actually working, and whether it is possible to operate his present apparatus without infringing upon complainant's patent.

And that, afterwards, on or about June, 1865, the said master, Charles B. Collier, esq., did thereupon report to the court that defendant was then working and manufacturing with less than seven per cent. of lime, and that a portion of his product, so manufactured, consisted of free fat acids, and that to avoid the production by defendant of free fat acids, it would be necessary for him to use eleven and a half per cent. of lime; and that the use by the defendant of his present apparatus so as not to infringe complainant's patent, is not practicable.

A copy of which report of the said master is hereto annexed, marked "E."

And your orator further shows that, afterwards, on or about March, 1865, a motion was made for an attachment of said defendant, Michael

Werk, for his contempt in disobeying the injunction of the court, and that, while said motion was pending, a compromise was effected between the said complaint and defendant, whereby said defendant paid to complainant the sum of fourteen thousand dollars, and received from complainant a release of all damages on account of his past violation and infringement of the said patent, and also a license to manufacture free fat acids according to the process patented to the complainant
293 during the remaining unexpired period of said patent until the ninth day of January, 1868, on the terms and conditions expressed in a written agreement between the said parties, dated 29th July, 1865, to be produced in court as your honors may direct, and a copy whereof is hereto annexed, marked "F."

And your orator further shows that a suit in equity was commenced in the circuit court of the United States for the southern district of New York, by your orator, against Roland G. Mitchell, of New York, for an infringement of said letters-patent. That said suit came to a final hearing at the session of said court held at New York, July, 1864, on bill, answers, and proof, and, being fully argued by counsel, it was ordered, adjudged, and decreed that the letters-patent, No. 11766, granted to said Richard A. Tilghman, October 3, 1854, is a good and valid patent, and the said Richard A. Tilghman was the original and first inventor of the improvement described and claimed in said patent.

And your orator further shows that your orator has extensively applied the said improvements to practical use, and has been, and, but for the infringement hereinafter complained of, would still be, in undisturbed possession, use, and enjoyment of the exclusive privilege secured by the said letters-patent, and in receipt of the profits of the same.

And your orator further shows that, prior to the 9th January, 1868, the following-named persons, corporations, and commercial firms, to wit, N. Ropes & Company, of Cincinnati; The Ohio Candle Company, of Cincinnati; Proctor & Gamble, of Cincinnati; Cornwall & Brother, of Louisville, Kentucky; E. Schneider & Company, of Chicago, Illinois; and A. Gross & Company, of New York, had, for a long time, extensively used and employed the said patented improvements in their manufacture and business, by the license of your complainant, during the original term of his said patent, which expired January 9, 1868; and that, since the 9th January, 1868, the said parties have continued
294 to use and work, and are now using and working, said patented improvements, by license of said complainant, under the renewal and extention of said patent, upon substantially the same terms and conditions as theretofore and prior to the 9th January, 1868.

And your orator further shows that, upon the 30th December, 1867, and 23d January, 1868, the said complainant sent by mail to said defendant two letters, offering them a license to use the said patented process, during the said extended term of the patent, upon substantially the same terms and conditions as those accepted by the parties last above named, and also notified said defendants to cease and desist from using and working said patented improvements from and after the 9th January, 1868, in case they neglected or declined to accept said license, as by duly authenticated copies of said letters to be produced in court as your honors may direct, reference being thereto had, will appear, copies whereof are hereto annexed, marked "G" and "H."

And that said defendants have hitherto wholly neglected to accept said offer, or to answer the said letters of the complainant; and that, as your orator is informed and believes, said defendants have used and continue to use the said patented improvements since and after the

9th day of January, 1868, notwithstanding complainant's express notice and prohibition.

And your orator further shows that your orator has extensively applied the said improvements to practical use, and has been, and, but for the infringement hereinafter complained of, would still be in the undisturbed possession, use, and enjoyment of the exclusive privileges secured by the said letters-patent, and in receipt of the profits of the same.

And your orator further shows unto your honors, as he is informed and believes, that the said defendants hereinafter named, well knowing all the facts hereinbefore set forth, are now constructing and using the said patented improvement, in some parts thereof substantially
295 the same in construction and operation as in the said letters-patent mentioned, the exclusive right and privilege to make and use which, and vend the same to others to be used, is thus by law vested in your orator.

And so it is, may it please your honors, that the said defendants, as your orator is informed and believes, without the license of your orator, against his will, and in violation of his rights, have made and used, and intend to still continue to make and use the said improvement within the southern district of Ohio, all of which is in violation of the said letters-patent and assignments.

To the end, therefore, that the defendants may, if they can, show reason why your orator should not have the relief hereby prayed, and that they may make a full disclosure and discovery of all the matters aforesaid, and upon their several corporal oaths, and according to the best and utmost of their knowledge, remembrance, information, and belief, full, true, direct, and perfect answer make to such of the several interrogatories hereinafter numbered and set forth, as by the note hereunder written, required to answer; that is to say:

1. Whether the said original letters-patent were granted and issued to the said Richard A. Tilghman on the 3d of October, 1854?

2. Whether the said patent was, on the 23d November, 1867, renewed and extended for the period of seven years from the 9th January, 1868?

3. Whether said defendants have, at any time since the 9th January, 1868, and if so, when and during what periods of time, manufactured any fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure?

4. State minutely and in detail the process pursued by defendants, since the 9th January, 1868, in the manufacture of fat acids and glycerine, stating particularly how many pounds of lime are used to each one hundred pounds of fat, and what is the temperature and pressure employed in the tank.

296 5. State minutely and in detail the process pursued by defendants immediately before the 9th January, 1868, in the manufacture of fat acids and glycerine, stating particularly how many pounds of lime to each one hundred pounds of fat, and what was the temperature and pressure employed in the tank.

6. Describe minutely and in detail the difference, if any, between the process pursued by defendants in the manufacture of fat acids and glycerine immediately before the 9th January, 1868, and that pursued by them since the 9th January, 1868.

And now, to the end that the defendants may be compelled to account for, and pay over the income thus unlawfully derived from, the violation of the rights of your orator, as above, and be restrained from any violation of said rights, your orator prays that your honors may grant a

writ of injunction, restraining the defendants from any further construction or sale, or use, in any manner, of said patented improvement, or any part thereof, in violation of the rights of your orator, as aforesaid; and that the machine or machines now in possession or use of the said defendants may be destroyed, or delivered up to your orator for that purpose. And your orator prays for such other relief as the equity of the case may require, and to your honors may seem meet.

May it please your honors to grant unto your orator not only a writ of injunction conformable to the prayer of this bill, but also a writ of subpœna of the United States of America, directed to the said Michael Werk, Thomas Kirby, John Kirby, and M. Schwartz, and commanding them to appear and answer unto this bill of complaint, and to abide and perform such order and decree in the premises as to the court shall seem meet and be required by the principles of equity and good conscience.

R. A. TILGHMAN.

SAM'L S. FISHER,
Solicitor for Complainant.
GEORGE HARDING,
Of Counsel.

297 The defendants are required to answer each of the foregoing interrogatories, numbered from one to six, inclusive.

SAM'L S. FISHER,
Solicitor for Complainant.

I acknowledge myself security for all costs for which the complainant may be liable in the above writ.

C. T. JONES.

On the twenty-first day of February, 1868, before the subscriber, came Richard A. Tilghman, the complainant in the foregoing bill named, , being duly sworn, says that, so far as the statements therein contained are within his own knowledge, they are true; and so far as they are derived from the information of others, he verily believes them to be true. And he further says that he verily believes the said Richard A. Tilghman, in said bill named, is the original, true, and first inventor of the new and useful improvement in processes for purifying fatty bodies, which is described in the letters-patent granted to Richard A. Tilghman, and mentioned in the foregoing bill. And your deponent verily believes that the title of him the complainant, as set forth in said bill, is true.

RICHARD A. TILGHMAN.

Sworn to and subscribed this twenty-first day of February, A. D. 1868, before me.

AUBREY H. SMITH,
U. S. Commissioner.

298 EXHIBIT A.

(No. 11766.)

The United States of America, to all to whom these letters-patent shall come:

Whereas Richard A. Tilghman, of Philadelphia, Pa., has alleged that he has invented a new and useful improvement in processes for purify-

ing fatty bodies, which he states has not been known or used before his application; has made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said improvement, and that the same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the Treasury of the United States the sum of thirty dollars, and presented a petition to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose: These are, therefore, to grant, according to law, to the said Richard A. Tilghman, his heirs, administrators, or assigns, for the term of fourteen years from the 9th day of January, one thousand eight hundred and fifty-four, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvement, a description whereof is given in the words of the said Tilghman, in the schedule hereunto annexed, and is made part of these presents.

In testimony whereof I have caused these letters to be made patent, and the seal of the Patent-Office has been hereunto affixed.

Given under my hand at the city of Washington, this third of October, in the year of our Lord one thousand eight hundred and fifty-four, and of the Independence of the United States of America the seventy-ninth.

ROBERT McCLELLAND,
Secretary of the Interior.
C. MASON,
Commissioner of Patents.

[SEAL.] Countersigned and sealed with the seal of the Patent-Office.

299 The schedule referred to in these letters-patent, and making part of the same.

To all whom it may concern:

Be it known that I, Richard Albert Tilghman, of Philadelphia, have invented a new and improved mode of treating fatty and oily bodies, and I hereby declare that the following is a full and exact description thereof.

My invention consists of a process for producing free fat acids and solution of glycerine from those fatty and oily bodies of animal and vegetable origin which contain glycerine as their base. For this purpose I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine. I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting point of lead, until the operation is complete. The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of water into steam.

The process may be performed more rapidly and also continuously by causing the mixture of fatty matter and water to pass through a tube or continuous channel, heated to the temperature already mentioned, the requisite pressure for preventing the conversion of water into steam being applied during the process. And this I believe is the best mode of carrying my invention into effect.

In the drawing hereunto annexed are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention.

Fig. 1 of the said drawing is a vertical section of this apparatus,
300 and Figure 2 shows the various parts of the apparatus in horizontal section; similar parts in these figures being marked with similar letters of reference.

I place the fat or oil in a fluid state in the vessel *a*, with from one-third to one-half its bulk of warm water; the disc or piston *b*, perforated with numerous small holes, being kept in rapid motion up and down in the vessel *a*, causes the fat or oil and water to form an emulsion or intimate mechanical mixture. A force pump, *c*, like those in common use for hydraulic presses, then drives the mixture through a long coil of very strong iron tube *d d d d*, which, being placed in the furnace *e e*, is heated by a fire, *f*, to about the temperature of melting lead. From the exit end *g*, of the heating tubes *d d*, the mixture, which has then become converted into free fat acids and solution of glycerine, passes on through another coiled iron tube *h h h* immersed in water, by which it is cooled down from its high temperature to below 212° Fahrenheit, after which it makes its escape through the exit valve *i* into the receiving vessel.

The iron tubes I have employed and found to be convenient for this purpose are about one inch external diameter, and about half an inch internal diameter, being such as are in common use for Perkins' hot-water apparatus. The ends of the tubes are joined together by welding, to make the requisite length; but where welding is not practicable, I employ the kinds of joints used for Perkins' hot-water apparatus, which are now well-known. The heating tube *d d d* is coiled several times backwards and forwards, so as to arrange a considerable length of tube in a moderate space. The different coils of the tube are kept about a quarter of an inch apart from each other, and the interval between them is filled up solid with cast iron, which also covers the outer coils or rows of tubes to the thickness of half or three-quarters of an inch, as shown in figure 2. This casing of metal insures a considerable uniformity of temperature in the different parts of the coil, adding also to its strength, and protecting it from injury by the fire.

301 The exit-valve *i* is so loaded that when the heating tubes *d d d* are at the desired working temperature, and the pump *c* is not in action, it will not be opened by the internal pressure produced by the application of heat to the mixture; and, therefore, when the pump *c* is not in action, nothing escapes from the valve *i* if the temperature be not too high. But when the pump forces fresh mixture into one end *j* of the heating tubes *d d d* the exit valve *i* is thereby forced open to allow an equal amount of the mixture, which has been operated upon, to escape out of the cooling tubes *h h* at the other end of the apparatus. No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture. For this purpose, whenever it may be required, the speed of the pump should be increased, so that the current through the tubes may be sufficiently rapid to carry out with it any air remaining in them.

Although the decomposition of the neutral fats by water takes place with great quickness at the proper heat, yet I prefer that the pump *c* should be worked at such a rate, in proportion to the length or capacity of the heating tubes *d d d* that the mixture, while flowing through them, should be maintained at the desired temperature for ten minutes before it passes into the refrigerator or cooling parts *h h* of the apparatus.

The melting point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matters into fat acid and glycerine takes place with some materials (such as palm-oil) at or below the melting point of bismuth, yet the heat has been carried considerably above the melting point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat, and gradually increasing it, the temperature, giving products most suitable to the intended application of the fatty bodies employed, can easily be determined.

To indicate the temperature of the tubes *d d d* I have found the successive melting of metals and other substances of different
302 and known degrees of fusibility to be convenient in practice; several holes, half an inch in diameter, and two or three inches deep, are bored into the solid parts of the castings surrounding the tubes, each hole being charged with a different substance. The series I have used consist of tin melting about 440° F.; bismuth at about 510° F.; lead at about 612° F.; and nitrate of potash at about 660° F. A straight piece of iron wire passing through the side of the furnace to the bottom of each of the holes, enables the workman to feel which of the substances are melted, and to regulate the fire accordingly. It is important, for the quickness and perfection of the decomposition, that the oil and water, during their entire passage through the heating-tubes, should remain in the same state of intimate mixture in which they enter them. I, therefore, prefer to place the series of heating-tubes in a vertical position, so that any partial separation which may take place, while the liquids pass up one tube, may be counteracted as they pass down the next. I believe that it will be found useful to fix at intervals in the heating-tubes, diaphragms pierced with numerous small holes, so that liquids being forced through those obstructions with velocity, may be thoroughly mixed together.

I deem it prudent to test the strength of the apparatus by a pressure of ten thousand pounds to the square inch, before taking it into use; but I believe that the working pressure necessary, in using the heat I have mentioned, will not be found to exceed two thousand pounds to the square inch.

When it is desired to diminish the contact of the liquids with iron, the tubes or channels of the apparatus may be lined with copper. The hot mixture of fat acids and solution of glycerine which escapes from the exit valve of the apparatus separates by subsidence. The fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means.

The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soaps, and
303 applied to various purposes, according to their quality; and, when desired, they may also be first bleached by chemical agents, or purified by distillation, in a current of steam, or in a vacuum, as is now well understood. I prefer that the fatty bodies should be previously deprived, as far as practicable, of such impurities as would cause the discoloration of the fat acids produced; but when the fat acids are to be finally purified by distillation, this preliminary purification is of less importance.

When the sulphuric acid, nitrous fumes, or other corrosive agent, shall have been used for purifying, hardening, or otherwise preparing the fatty body to be operated upon, I take care that all traces of it shall be washed out, or neutralized, before passing it through the apparatus.

Some fatty bodies (particularly when impure) generate, during the process, a portion of acetic or other soluble acid, which might tend to injure the iron tubes. In such cases I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes.

Having now described the nature of my invention, and the manner of performing the same, I hereby declare that I claim, as of my invention, the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure.

R. A. TILGHMAN.

Witnesses—
JAMES MCCURLEY,
JOHN R. DARKER,
Consulate of the United States, London.

304 EXHIBIT B.

Whereas, upon the petition of Richard A. Tilghman, of Philadelphia, Pennsylvania, for the extension of the patent granted to him October 3, 1854, antedated January 9, 1854, the undersigned, in accordance with the eighteenth section of the act of Congress, approved the 4th day of July, 1836, entitled "An act to promote the progress of the useful arts, and to repeal all acts and parts of acts heretofore made for that purpose," and the act approved the 27th day of May, 1848, entitled "An act to provide additional examiners in the Patent-Office, and for other purposes," did, on this 23rd day of November, 1867, decide that said patent ought to be extended: Now, therefore, I, Thomas C. Theaker, Commissioner of Patents, by virtue of the power vested in me by said acts of Congress, do renew and extend the said patent, and certify that the same is hereby extended for the term of seven years, from and after the expiration of the first term, viz, from the 9th day of January, 1868; which certificate being duly entered of record in the Patent-Office, the said patent has now the same effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof I have caused the seal of the Patent-Office to be hereunto affixed, this 23rd day of November, 1867, and of the Independence of the United States the ninety-second.

(Signed) T. C. THEAKER, *Commissioner.*

[SEAL OF THE PATENT-OFFICE.]

(Here follows diagram marked page 305.)

307 EXHIBIT C.—*Decree.*

RICHARD A. TILGHMAN
vs.
MICHAEL WERK. } 1270. Chancery.

This cause having been heard upon the bill, answer, pleadings, exhibits, and proofs, (at the October term, A. D. 1860,) and argued by counsel for the respective parties, and taken under advisement, and the court being now fully advised in the premises, do find the equity of the case to be with the plaintiff; and it is thereupon ordered, adjudged, and decreed, that the patent granted to Richard A. Tilghman, October 3, 1854, and set forth in the bill filed, is valid, and that the plaintiff is thereby vested with the exclusive right thereby granted as therein

claimed; and it is further ordered, adjudged, and decreed, that the defendant has disturbed, violated, and infringed upon the complainant in his exclusive rights as in the said bill set forth.

And it is further ordered, adjudged, and decreed, that the plaintiff recover of the defendant the profits and gain, or such sum as the court may hereafter decree to be recoverable by him, made and received in consequence of the infringement and violations of the exclusive rights of the complainant, which it is adjudged have been so committed by the defendant; and that complainant is also entitled to recover costs of the defendant. And further, that it be, and it is hereby, referred to Charles B. Collier, esq., as master, to compute and ascertain the damages to which the plaintiff is entitled. And the said master in making up an account of the damages sustained by the plaintiff, by reason of the defendant's infringement of the plaintiff's patent, is directed to make out said account as to him shall seem just: and may also make out an account upon the principles which may be required by either party, so that the court can on final hearing settle the amount to be recovered upon just principles. And it is further ordered that
308 the defendant be enjoined from manufacturing free fat acid by the process secured to the plaintiff by his said patent as set forth in his said bill of complaint: Provided, however, that this injunction shall not prevent the defendant from using his closed tank for manufacturing, not infringing plaintiff's patent, as the exclusive use of a closed tank is not, in the opinion of the court, a part of the plaintiff's rights secured by his patent; and for the coming in of the master's report, this cause is continued.

EXHIBIT D.

RICHARD A. TILGHMAN }
vs.
MICHAEL WERK. }

1. Plaintiff's invention consists in a process for manufacturing free fat acids and glycerine by the action of water in a liquid state above the ordinary boiling point of water, and consequently under pressure, on fatty bodies or substances.
2. The invention is based on a discovery made by plaintiff, that water highly heated and under pressure, of itself, possesses a chemical power of decomposing fat bodies into their elements, fat acid and glycerine.
3. This invention and discovery are not contained in the books relied on by the defendant. Regnault's and Payen's process acts by destroying the glycerine, and does not mention highly-heated water under pressure as the decomposing agent, and is, therefore, unlike the plaintiff's.
4. Milly & Motard's process, described in Roret's Encyclopedia, although using a close boiler, containing fat and water under a high temperature and pressure, yet does not rely on the chemical decomposing power of highly-heated water, but requires the presence of lime to combine with all the fat, and thus prevents the formation of any free fat acid, and is, therefore, unlike the plaintiff's.

309 5. Arthur Dunn's process by use of soda is similar to that of Milly & Motard, and unlike the plaintiff's.

6. The plaintiff's invention is a useful and practical one.

Some fatty bodies (particularly when impure) generate, during the process, a portion of acetic or other soluble acid, which might tend to injure the iron tubes. In such cases I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes.

Having now described the nature of my invention, and the manner of performing the same, I hereby declare that I claim, as of my invention, the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure.

R. A. TILGHMAN.

Witnesses—
JAMES MCCURLEY,
JOHN R. DARKER,
Consulate of the United States, London.

304 EXHIBIT B.

Whereas, upon the petition of Richard A. Tilghman, of Philadelphia, Pennsylvania, for the extension of the patent granted to him October 3, 1854, antedated January 9, 1854, the undersigned, in accordance with the eighteenth section of the act of Congress, approved the 4th day of July, 1836, entitled "An act to promote the progress of the useful arts, and to repeal all acts and parts of acts heretofore made for that purpose," and the act approved the 27th day of May, 1848, entitled "An act to provide additional examiners in the Patent-Office, and for other purposes," did, on this 23rd day of November, 1867, decide that said patent ought to be extended: Now, therefore, I, Thomas C. Theaker, Commissioner of Patents, by virtue of the power vested in me by said acts of Congress, do renew and extend the said patent, and certify that the same is hereby extended for the term of seven years, from and after the expiration of the first term, viz, from the 9th day of January, 1868; which certificate being duly entered of record in the Patent-Office, the said patent has now the same effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof I have caused the seal of the Patent-Office to be hereunto affixed, this 23rd day of November, 1867, and of the Independence of the United States the ninety-second.

(Signed) T. C. THEAKER. *Commissioner.*

[SEAL OF THE PATENT-OFFICE.]

(Here follows diagram marked page 305.)

307 EXHIBIT C.—*Decree.*

RICHARD A. TILGHMAN *vs.* MICHAEL WERK. } 1270. Chancery.

This cause having been heard upon the bill, answer, pleadings, exhibits, and proofs, (at the October term, A. D. 1860,) and argued by counsel for the respective parties, and taken under advisement, and the court being now fully advised in the premises, do find the equity of the case to be with the plaintiff; and it is thereupon ordered, adjudged, and decreed, that the patent granted to Richard A. Tilghman, October 3, 1854, and set forth in the bill filed, is valid, and that the plaintiff is thereby vested with the exclusive right thereby granted as therein

claimed; and it is further ordered, adjudged, and decreed, that the defendant has disturbed, violated, and infringed upon the complainant in his exclusive rights as in the said bill set forth.

And it is further ordered, adjudged, and decreed, that the plaintiff recover of the defendant the profits and gain, or such sum as the court may hereafter decree to be recoverable by him, made and received in consequence of the infringement and violations of the exclusive rights of the complainant, which it is adjudged have been so committed by the defendant; and that complainant is also entitled to recover costs of the defendant. And further, that it be, and it is hereby, referred to Charles B. Collier, esq., as master, to compute and ascertain the damages to which the plaintiff is entitled. And the said master in making up an account of the damages sustained by the plaintiff, by reason of the defendant's infringement of the plaintiff's patent, is directed to make out said account as to him shall seem just; and may also make out an account upon the principles which may be required by either party, so that the court can on final hearing settle the amount to be recovered upon just principles. And it is further ordered that
308 the defendant be enjoined from manufacturing free fat acid by the process secured to the plaintiff by his said patent as set forth in his said bill of complaint: Provided, however, that this injunction shall not prevent the defendant from using his closed tank for manufacturing, not infringing plaintiff's patent, as the exclusive use of a closed tank is not, in the opinion of the court, a part of the plaintiff's rights secured by his patent; and for the coming in of the master's report, this cause is continued.

EXHIBIT D.

RICHARD A. TILGHMAN }
vs.
MICHAEL WERK. }

1. Plaintiff's invention consists in a process for manufacturing free fat acids and glycerine by the action of water in a liquid state above the ordinary boiling point of water, and consequently under pressure, on fatty bodies or substances.

2. The invention is based on a discovery made by plaintiff, that water highly heated and under pressure, of itself, possesses a chemical power of decomposing fat bodies into their elements, fat acid and glycerine.

3. This invention and discovery are not contained in the books relied on by the defendant. Regnault's and Payen's process acts by destroying the glycerine, and does not mention highly-heated water under pressure as the decomposing agent, and is, therefore, unlike the plaintiff's.

4. Milly & Motard's process, described in Roret's Encyclopedia, although using a close boiler, containing fat and water under a high temperature and pressure, yet does not rely on the chemical decomposing power of highly-heated water, but requires the presence of lime to combine with all the fat, and thus prevents the formation of any free fat acid, and is, therefore, unlike the plaintiff's.

309 5. Arthur Dunn's process by use of soda is similar to that of Milly & Motard, and unlike the plaintiff's.

6. The plaintiff's invention is a useful and practical one.

7. The description of the process is sufficient in the specification. A fixed rule is given, which will certainly insure success, and it is also made known that certain variations may be made without changing the process.

8. A principle and a process distinguished. The invention claimed by plaintiff is a process, not a principle.

9. The process used by defendant is an infringement of plaintiff's patent:

I. Defendant uses and requires water in his process.

II. That water is highly heated and under pressure.

III. That water decomposes a certain portion of the fatty body into free fat acid and glycerine, and to this extent infringes.

IV. The defendant also employs six or seven pounds of lime to one hundred pounds of fat, and thus converts a certain portion of fat into lime-soap, and that portion of the operation does not infringe.

10. In a patent for a process, a defendant cannot avail himself of the process to a partial extent without infringing.

11. The amount which the plaintiff should recover is to be measured by the profit which the defendant has derived from the adoption and use of the plaintiff's invention.

This was a suit in equity, brought by R. A. Tilghman, upon letters-patent of the United States, granted to him October 3, 1854, for a new and useful improvement in processes for purifying fatty bodies, against Michael Werk. The bill of complaint charged that the defendant had infringed the exclusive right secured to him by the letters-patent, by the use of a certain apparatus and process employed by the defendant in the manufacture of fat acid at his establishment in Cincinnati. The defendant alleged that the plaintiff was not the original and first inventor of the process for which the letters-patent were
310 granted to him, but that substantially the same process was described in Payen's Chemistry in the year 1851, in Regnault's Chemistry, published in the year 1853, and in Roret's Encyclopedia. The defendant also denied that the process or plan employed by him was an infringement of the complainant's letters-patent, but, on the contrary, alleged it to be a new and independent invention, for which the defendant obtained letters-patent, October 5, 1858.

A large amount of scientific testimony was taken. The case came on for final hearing on bill, answer, and proofs before Justice McLean and Judge Leavitt, sitting at Cincinnati, November, 1860. It was argued at great length, for the complainant, by Henry Stanberry and George Harding, esquires, and for respondents by Charles Fox and Nathaniel McLean, esquires.

The case was held under advisement, and Judge Leavitt delivered the following opinion at a special term of the court holden February 21, 1862. Justice McLean had, as will appear by the opinion expressed, prior to his death, a concurrence of views with those held by Judge Leavitt:

Opinion of the court, delivered by Leavitt, J.

As explanatory of the delay which has occurred in the decision of this case, it is proper to remark that it was argued before Judge McLean and myself, near the close of the October term, 1860. A short time after the argument, and before he could prepare an opinion, that distinguished and lamented judge left this city to take his place in the Su-

preme Court at Washington. After some conference in relation to the case, from which it was apparent there was an entire concurrence of views between the judges as to all the principal points, it was arranged that Judge McLean should take the papers, and write an opinion at Washington. Owing propably to his feeble health through the winter, resulting in his death, he did not, so far as I am informed, state
311 his views in writing, and now, under some disadvantages certainly, it has devolved on me to announce the conclusions of the court.

The plaintiff, Tilghman, has filed his bill in equity, claiming to be the first and original discoverer of a new and useful improvement in the process for the decomposition of fatty substances and oils for practical purposes. He alleges that the exclusive right to his invention is secured to him by letters-patent granted by the United States, dated the 3d of October, 1854; and that the defendant, Werk, has violated the right thus secured to him under his patent, by the use of a certain apparatus and process in the manufacture of fat acids at the city of Cincinnati. The bill prays for a discovery as to the matters alleged, and such relief as the equity of the case may require.

In his answer, the defendant denies, in the first place, that the plaintiff is the first and original discoverer of the method or process described in his specification and covered by his patent; and avers substantially the same process was known long before the date of the plaintiff's patent, and in practical use in France, and is described in several published works in that country, the authors and compilers of which are named and specifically referred to. The defendant also denies any infringement of the rights of the plaintiff under his patent, and avers that the method or process used by him is essentially different from that claimed and described by the plaintiff, and is the product of his own invention, and is secured to him by a patent granted the 5th of October, 1858. The answer further alleges, in substance, that the improvement claimed by the plaintiff is of no value, and incapable of being practically and economically used by manufacturers.

The plaintiff, in his specification, describes the nature of his improvement as follows: "My invention consists of a process for producing free fat acids and solution of glycerine from those fatty and oily bodies of animal and vegetable origin which contain glycerine as their base.
312 For this purpose, I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of these bodies to combine with water, and thereby obtain, at the same time, free fat acids and solution of glycerine. I mix the fatty body to be operated upon with from a-third to a-half of its bulk of water, and the mixture may be placed in any convenient vessel, in which it can be heated to the melting-point of lead, until the operation is complete. The vessel must be closed, and of great strength, that the requisite amount of pressure may be applied, to prevent the conversion of the water into steam."

This comprehends substantially the nature of the invention claimed by the plaintiff as new and original. The other part of the specification describes minutely and with great clearness the apparatus and appliances by which the proposed result is produced. It is not necessary to notice critically the process as described, as the defendant's answer takes no exception to the sufficiency of the specification.

As to the originality of the invention claimed by the plaintiff and covered by his patent.

It appears from the above extract from the specification, that the in

vention of the plaintiff consists in a process for the manufacture of fat acids and glycerine by the action of water in a liquid state above the ordinary boiling-point of water, and, consequently, under pressure, on fatty bodies or substances. The invention is based on the discovery claimed by the plaintiff to be original with him, that water, under the conditions above set forth, of itself possesses a chemical power of decomposing or separating fat bodies into their elements, fat acid and glycerine.

Now, the answer of the defendant sets up, that the same process is described in Payen's Chemistry, published in the year 1851; in Regnault's work on Chemistry, published in 1853; and in Roret's Encyclopedia. These are all French publications, of dates anterior to the date of the plaintiff's patent; and under the patent laws of the United States, if any of the processes
313 described are identical with the invention claimed by plaintiff, it is fatal to the validity of his patent. By reference to these publications, and to the testimony of the distinguished experts, which is before the court, the influence seems to be irresistible, that there is a substantial difference between the processes they describe and that patented by the plaintiff. Neither of the works referred to describe or notice any such chemical decomposing power, pertaining to water at a high temperature and under pressure, which constitutes the main elements in the discovery claimed by the plaintiff. Regnault and Payen describe a process of decomposition consisting in a separation of fat acids by the destruction of glycerine, one of the elements of the fatty body, but do not mention the use of water highly heated under pressure as the decomposing agent. In the description contained in Roret's Encyclopedia, lime is required as a decomposing agent, in quantities sufficient to effect the separation of the fatty body into fat acid and glycerine. No allusion is made to the process described by the plaintiff, and which is the distinguishing feature of his invention. In confirmation of this view of the publications referred to, and as conclusive of the point under consideration, it may be remarked that the experts examined on behalf of the plaintiff—Professors Booth, Rogers, and Genth, gentlemen of distinguished reputation in the walks of science, and who profess to be acquainted with the French works referred to, unite in saying that they describe no processes resembling or identical with that described by and patented to the plaintiff. They also agree in saying that, in so far as their knowledge and research extend, there is no publication extant which describes the plaintiff's process, and, in their judgment, it is new and original with him; and even the scientific gentlemen who have testified as experts in behalf of the defendant do not say that they have knowledge of any work or publication, dating back of the plaintiff's patent, which describes his process. The invention of Milly & Motard, described in Roret's Encyclopedia, is perhaps a nearer approximation to that of the
314 plaintiff than any other referred to by the defendant. They describe a close boiler, in which the fat and water were subjected to the action of high temperature and pressure. But in their process they do not rely on these agencies to effect the separation of the elements of the fatty bodies, but require lime in sufficient quantities to combine with all the fat, and thus prevent the formation of any free fat acid.

So, too, it appears that, in the patent of Arthur Dunn, described in vol. II, 2d series of the Repertory of Patent Inventions, he used a steam-tight vessel, and applied a temperature of 310° Farenheit, and by the use of soda produced a soda-soap, and not free fat acids.

It is obvious that, in all the descriptions of these processes, they are essentially different from the plaintiff's invention, by whose apparatus free fat acid is produced solely by the chemical action of water at a high temperature under pressure.

It is certainly true that some of the discoveries referred to, especially Milly & Motard, and Dunn, approached very nearly to the discovery of the plaintiff; but as certainly stopped short of the object. They failed to reach the important chemical truth, that highly-heated water under pressure will produce from fatty bodies free fat acid and solution of glycerine, without any other agency.

This view is most convincingly exhibited by the testimony of the experts who have been examined as witnesses. It is also sustained by the Commissioner of Patents, who, in his note to the defendant Werk, of June 26th, 1858, rejecting his first application for want of novelty, distinctly informs him that Mr. Tilghman is the acknowledged discoverer of this process.

I have no hesitation in concluding that the attempt to invalidate the plaintiff's patent, for want of originality in his invention, has wholly failed.

The patent, however, is assailed on other grounds, which I will briefly notice.

315 1. It is insisted that while it may be practicable to separate fatty bodies by the action of heated water, according to the plaintiff's process, it cannot be economically and practically used, and therefore the invention patented is of no utility. The defendant in his answer, while he does not take issue distinctly on the utility of the invention, alleges that it is liable to two objections, which prevent it from being of practical use. The first is, that the great heat required to produce the result proposed, will speedily destroy or greatly injure the tank and pipes employed; and, second, that so much time is required in completing the process, that practically it is of no utility.

As to this point, it is only necessary to advert to the familiar principle in the law of patent-rights, that a presumption of the utility of an invention arises from the grant of the patent; and this presumption can only be repelled by clear proof that it is utterly worthless. There is not only no such evidence in this case, but it is proved, upon actual experiments, that the plaintiff's process has been successfully applied to practical use. What may be the degree of utility is not an inquiry pertinent to the question under consideration, but may, perhaps, form a proper subject of inquiry hereafter, if it is proved that the defendant has infringed the plaintiff's patent, in estimating the quantum of injury which has been sustained.

2. It is also contended by the defendant's counsel, that the patent of the plaintiff is a nullity, because it does not describe the process with sufficient precision, by which the result claimed is to be produced, and that no one, though skilled in the business, could determine, except by experiment, the precise degree of heat required.

On this point it may be remarked, in the first place, that the defendant has offered no evidence tending to prove the existence of any
316 practical difficulty in the use of the processes described in the plaintiff's specification. The learned experts who have testified for him say they have tested the practicableness of the described processes, by actual and successful experiments. And it also appears from the evidence of the witnesses Ropes and Grant, that they have actually produced free fat acids and solution of glycerine, by the plaintiff's process, making no mention of any difficulty from the want of exactness in

the specification, as to the degree of heat required. And, referring to the specification, it seems to be sufficiently explicit to answer the requirements of the statute, construed in the liberal spirit in which, by repeated judicial decision, this instrument should be viewed. The language of the specification in reference to the temperature of the heated water is as follows: "The melting-point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matter into fat acid and glycerine takes place with some materials (such as palm-oil) at or below the melting-point of bismuth, yet the heat has been carried considerably above the melting-point of lead, without any apparent injury, and the decomposing action of water becomes more powerful as the heat is increased."

Now it is well known that lead melts at 612° Fahrenheit, and bis*buth* at about 510°. There is, then, a precise degree of heat—612°—recommended and prescribed as sure to produce a good result in changing common fatty bodies to acid and glycerine, and a lower temperature, the melting-point of bismuth—510°—when palm-oil or similar substances are to be operated upon. And it clearly does not render the specification liable to objection for want of certainty and clearness, that the patentee states that the degree of heat may be carried above these figures without injury. Nor is the sufficiency of the description impeached by the fact that the desired result has been produced at a lower temperature of water. There is a fixed rule given which may be safely fol-
317 lowed, while it is made known that the manufacturer may safely depart to some extent from this rule, if, from experiment and a just exercise of discretion, it should be expedient to do so. This specification is not, therefore, liable to the objection urged in argument, and so often referred to in the books, that the process described cannot be carried out without the necessity of previous experiments.

Another ground of objection to the validity of the patent is, that it is merely for a principle, and not for a process, and therefore void.

It seems to the court this objection is fully met by a reference to the words of the patentee, in describing his invention. In the introductory part of his specification he claims to have invented "a new and improved mode of treating fatty and oily bodies," and continues as follows: "My invention consists of a process for producing free fat acids and solution of glycerine," &c.

Now it is well settled, and needs no citation of authorities to prove it, that the discovery of a new and abstract principle in science or mechanics cannot be the subject of a patent. And clearly if this patentee has discovered merely the principle, or scientific fact that superheated water by its own power will effect the decomposition or separation of fatty substances into acids and solution of glycerine, he could not have obtained a patent; or if a patent issued, it would be void.

But he claims and has described more than this. He claims the discovery of a new principle, and process by which that principle may be made practical and operative. This process is minutely and fully described, and that is all the law requires. It has been adjudged a patentable invention by the officer of the Government selected with special reference to his qualification for the position, and by him a patent has been issued, securing to the patentee the exclusive benefit of his invention, for the term prescribed by law. I do not feel called upon to
318 overrule and set aside the judgment of the Commissioner of Patents in the case now before me.

The next inquiry relates to the question of infringement.

The bill alleges that the defendant "is now constructing and using the said patented improvement, in some part thereof substantially the same in construction and operation as in said letters patent mentioned.

On the point of infringement a mass of evidence has been offered on both sides, and it has been discussed at length by counsel. Without reviewing the evidence in its details, I will state, as concisely as I can, the conclusions to which I have arrived; and I may remark that as there seems to be no controversy as to the process or appliances by which the defendant decomposes fatty bodies, it is unnecessary here to describe them with minuteness.

The sole inquiry is, whether the mode or process used by the defendant is substantially *in*dentical, in whole or in part, with that patented to, and used by, the plaintiff.

The invention of the plaintiff has been already sufficiently noticed.

As to the defendant's invention it appears that, in May, 1858, he applied for a patent, and filed his specifications describing his invention, and the process by which it was to be made practical. He there claimed as his invention "the manufacture of fat acids by subjecting fatty or oleaginous bodies to the direct action of superheated steam, either with or without the use of other agents."

This application was rejected for the reason stated by the Commissioner, that the invention claimed by the defendant was covered by the previous patent granted to the plaintiff.

The defendant filed a new application, in which he modified his original claim and describes his invention as consisting "in the combination and arrangement of the apparatus as herein set forth, for
319 the saponification of fatty bodies." And this he proposes to effect by the direct application of superheated steam to the mass of oil or other fatty substances, and thus producing fat acids without distillation or the direct application of fire. In his conclusion he claims as new, "the combination of boiler, superheating furnace, and tank." In the description of his process, he says: "The superheated steam alone of a temperature of from 800° to 900° Far. will effect the decomposition, but acids and alkalies may be used in combination with the superheated steam to render so high a temperature unnecessary." He then states that, at a temperature of from 400° to 500° Far., the use of seven pounds of lime and fifty pounds of water to every one hundred pounds of fatty matter will be sufficient for the superheated steam. Thus modified, a patent was granted to the defendant, the 5th of October, 1858.

In his answer, the defendant calls his invention "a combination of machinery, or improvement in apparatus for manufacturing fatty acids, etc., by superheated steam, and a tight tank by which the fatty acids are produced without distillation, or the direct action of fire." He also states that the fatty substances are placed in the tank closed at the top to retain the heat and steam, with six or seven pounds of lime, and one hundred and thirty pounds of water to every one hundred pounds of fatty matter, and introduces steam heated to 340° or 350° Far., which, in connection with the action of the lime and water, produces a lime-soap, and sets the glycerine free in five hours after the operation is begun. The lime-soap is afterwards decomposed by the use of sulphuric acid, and the fat acids become free.

This synopsis of the defendant's invention, as described and used by him, sufficiently exhibits its essential features. And the question for decision is, whether, in any of its processes or modes of operation, it infringes any right granted to the plaintiff by his patent.

It has been before stated that the claim of the plaintiff is in substance that, by his process superheated water under pressure
320 is the sole agent in the decomposition of fatty substances, and separating them so as to form free fat acids and solution of glycerine.

Does the defendant's process effect, or is it capable of effecting, the same result by substantially similar means?

In giving an answer to this question, it is unnecessary to institute a critical comparison of the machinery and appliances respectively used by the patentees. It is not controverted that they are essentially alike. The defendant produces the heat necessary to decompose the fatty mass in his tank, by the use mainly of steam heated to a high temperature, which necessarily causes the water forming a part of the contents of the tank to rise to the same temperature as the steam, thus avoiding the direct application of fire to the tank, according to the process he describes; and by his distinct admission in his answer a portion of water is used as a decomposing agent. It is also proved by the witnesses that, in the defendant's process, water is required and used. And it is clear that, in that process, it is the superheated water, necessarily under pressure, which effects, to a certain extent, the decomposition of the fatty contents of the tank.

The scientific gentlemen examined as witnesses for the plaintiff unite in saying, after full experiments, that, in their judgment, this result is due to the chemical action of the superheated water, on the precise principle of the plaintiff's invention.

It is true that two experts, called as witnesses for the defendant, state it as their belief, not based, however, on experiment, that the decomposition cannot take place at a temperature of water less than 550° or 600°. And hence it is urged by the counsel for the defendant that there is no identity in the two processes.

In support of this view, it is insisted that in the defendant's process the water is heated only to 350° or 400°, and at that temperature can have no decomposing power, and, therefore, that the processes are essentially different in principle.

321 The fact relied upon to sustain this position is not made out by the evidence. The opinions of the two chemical experts referred to cannot prevail against the positive statements of no less than five witnesses, that by experiment it is found that at a temperature of 350° the heated water under pressure, as applied by the defendant, will produce free fat acid by its chemical action alone.

As I understand the law, the plaintiff's patent covers all the modes and processes by which the principle of his invention is made operative in practice. In Curtis on Patents, § 233, the author says: "These cases show that when a party has invented some mode of carrying into effect a law of natural science, or a rule of practice, it is the application of that law or rule which constitutes the peculiar feature of his invention; that he is entitled to protect himself from all other modes of making the same application; and consequently, that every question of infringement will present the question, whether the different modes, be it better or worse, is, in substance, an application of the same principle. The substantial identity, therefore, that is to be looked to in cases of this kind respects that which constitutes the essence of the invention, viz, the application of the principle."

On this point the authorities are numerous; but it seems to the court unnecessary to make a special reference to them. It is clear the plaintiff in this case does not, in his specification, restrict himself to any

certain or fixed temperature of heated water as necessary to produce the required result. He names the melting-point of lead, 612°, because, as he says, it is known to operate successfully; but he does not say, or intimate, that a higher or lower temperature may not be expedient or useful. He does, indeed, state, what would be entirely obvious without it, that the rapidity of the process of decomposition by the chemical action of the heated water will be in proportion to the degree of its heat. He has, therefore, in effect, provided for a much higher
322 temperature than 612° by recommending the use of a tank strong enough to resist a pressure of ten thousand pounds to the inch.

There is but one other point connected with the question of infringement, to which it seems necessary to advert. I refer to the position assumed by the counsel for the defendant, which, as I understand it, is, that if the defendant has adopted the principle of the plaintiff's invention in part only, and uses an agency in his process, not a part of the plaintiff's invention, he does not infringe his right under his patent.

It is contended, and the evidence proves it, that the defendant uses two distinct agents in his process. He has the superheated water, and in addition uses six or seven pounds of lime to each one hundred pounds of the fatty mass in the tank.

The result of this, as appears satisfactory from the evidence, is, that a part of this mass is converted into free fat acid, and a part is saponified, or converted into what some of the experts designate as an acid lime soap.

There seems to be no question that the production of the free fat acid is due solely to the decomposing power of the heated water, and the saponifying effect to the alkaline properties of the lime acting on the mass of fat.

As to the first of these effects, the production of free fat acid, the precise principle which constitutes the distinguishing feature of the plaintiff's invention, is clearly brought into requisition in the process.

As to the other—the saponifying action of the lime—there is no invasion of the plaintiff's claims, for the obvious reason that he does not name or provide for the use of lime in the process described in his specification.

Upon this state of facts the question is, has the defendant so far appropriated the invention of the plaintiff as to render him liable for an infringement? The answer to this inquiry seems so obvious that I shall not discuss it at any length.

323 The principle is undoubted that, in a patent for a mechanical structure, the novelty and utility of which consists wholly in a combination of things before known and in use, there is no infringement by the use of any of the separate parts of the combination.

But this principle can have no application to the present case. The gist of the plaintiff's invention is the discovery of a principle in science which he claims to have made practically useful by the process he describes. Now, it seems plain that he who adopts that principle to an available or practical extent, so far invades the exclusive right of the patentee. The logical sequence of the opposite doctrine would be that there could be no infringement unless the patented invention was adopted to the extent of producing the full results proposed by the patentee. In the case of this defendant, his discovery—which constitutes a distinct part of his claim—that a small percentage of lime will facilitate and hasten the decomposition of the fatty mass in the tank, may be and probably is useful and meritorious, and would well entitle him to a patent; but certainly it gave him no right to adopt the plain-

tiff's invention in giving effect to his own. His claim for a patent should have rested on the fact that he had discovered an improvement of the principle and process covered by the prior patent to the plaintiff. To the extent, therefore, that he has, without the license or authority of the plaintiff, adopted and used his process, the defendant is chargeable with an infringement.

It is, perhaps, to be regretted that the defendant, in applying for a patent, had not limited his claim to an improvement of the plaintiff's invention. In that form his patent would have been sustainable, and would have been beneficial, not only to the defendant but the public. It is in evidence that, under the old process of separating fatty matter for manufacturing purposes, fourteen pounds of lime was required to every one hundred pounds of the mass which produced lime-soap; and the separation of this soap into free fat acid and glycerine re-
324 quired the use of 35 per cent. of sulphuric acid. This was and expensive process; and the discovery that, through the joint agency of superheated water and 6 or 7 percentage of lime, the desired result could be speedily and successfully effected was an economical view, an important invention, and apparently of practical utility.

I cannot hesitate upon the law of this case, applicable to the facts proved, in holding—first, that the plaintiff's patent is valid to the extent of his claim; and, secondly, that the defendant has infringed upon the plaintiff's patented rights to the extent indicated. In the present posture of the case it is obvious no decree can be entered for damages arising from the infringement. The rule of compensation sanctioned by the express provision of the statute is the actual damage sustained by the plaintiff; and this damage is measured by the profit which the defendant has derived from the adoption and use of the plaintiff's invention. But in this case this adoption and use have only been to a partial extent, and there are no data before the court by which the profit to the defendant can be ascertained. The amount of the recovery in the case cannot be great, a. d it may be the plaintiff does not desire a decree for damages. While it is clear from the evidence that it is practicable by the plaintiff's process alone to effect the decomposition of a fatty mass as claimed by his patent, yet it is perhaps questionable whether it can be successfully adopted by the manufacturer. The evidence shows that about twenty hours are required to effect the desired result by this process; and some of the witnesses are positive that, in this country at least, the length of time required to perfect the process is a fatal objection to its practical use. It appears that those who have tried it have found it necessary to expedite the process of decomposition by the use of from one-half to two per cent. of lime; and with this addition the trials have been very successful. But the plaintiff, under the conviction that the use of superheated water under pressure would of itself
325 perfectly effect the desired end, has made no claim for the use of lime in his process, and cannot complain of its use as an invasion of his rights.

If the plaintiff desires it, the case will be referred to a master to inquire into and report the actual profit which the defendant has derived from the adoption and use of the plaintiff's process, to the extent it has been adopted and used by the defendant.

A decree may be entered in accordance with the views stated by the court.

UNITED STATES OF AMERICA,
Southern District of Ohio, ss:

I, John McLean, clerk of the circuit court of the United States for said district, certify that the above is a true copy of the original taken in this office. In testimony whereof I have hereunto set my hand and affixed the seal of said court this 22d February, A. D. 1862, and in the eighty-sixth year of the Independence of the United States of America.

[SEAL.] JOHN McLEAN, *Clerk.*

326 EXHIBIT E.

Circuit court of the United States.

RICHARD A. TILGHMAN, COMPLAINANT,
vs.
MICHAEL WERK, DEFENDANT.

To the honorable the judges of the circuit court of the United States for the 7th judicial circuit, southern district of Ohio.

On the 2d day of March, A. D. 1865, I, Charles B. Collier, special master in the above-entitled cause, was served with an order of which the following is a true and correct copy, to wit:

Circuit court of the United States for the southern district of Ohio.

"RICHARD A. TILGHMAN
"*vs.*
"MICHAEL WERK. } At chambers.

"It is ordered that the special master institute an examination of the defendant's apparatus and mode of working in the presence of both parties or their counsel, in order to ascertain with what percentage of lime defendant is actually working, and whether it is possible to operate his present apparatus without infringing upon complainant's patent."

Upon receipt of this order, I at once notified Samuel S. Fisher, esq., counsel for the complainant, and Samuel T. Harris, esq., of the
327 late firm of Fox & Harris, counsel for the defendant, of the receipt and nature of such order, and that, in obedience thereto, I should forthwith proceed to the defendant's manufactory, and there, in the presence of both parties and their counsel, if they desired to attend, make such examinations and tests as would enable me to report the facts to the court, directed to be reported upon in the said order. Having given such notices, and having also procured the services of Edward S. Wayne and Adolphus Fennel, two chemists of established reputation in their profession, as I have reason to believe, I proceeded to the manufacturing establishment of the defendant, and there, in the presence of the persons who I have named, except Samuel T. Harris, who did not attend, and in the presence of Thomas Kirby, the copartner of the defendant, and of one or more of the laborers of the establishment, procured from the tank or digester samples of the fatty matter then being treated, which samples I delivered to the said Edward S. Wayne and Adolphus Fennel, with instructions to them to carefully analyze the same and report to me the proportion or percentage of lime therein contained, and whether any, and if so what, quantity or proportion of free fat acid was produced by the process as then being conducted.

At this time it was concluded that the decomposition of the matter then contained in the tank had not progressed sufficiently to enable a satisfactory analysis to be made, and, accordingly, under my directions, additional samples were procured from the tank on the afternoon of the same day. When the decomposition was completed, the samples were delivered by me to the said Wayne and Fennel, with instructions as above stated. In order to arrive at the fact as to the quantity of lime with which the defendant was actually working, I also took the testimony of Thomas Kirby, defendant's copartner, who testified that, on that day, March 2, 1865, they were working with 7 (seven) per cent. of lime, and that such had been the quantity with which they had worked since October, A. D. 1864.

328 When advised by the said Edward S. Wayne and Adolphus Fennel that they had completed their analysis of the samples so given them, I proceeded to take their testimony as to the results thereof. The report was made to me as follows:

SPECIMEN 1.—*Lime-soap.*

	EDWARD S. WAYNE,	ADOLPHUS FENNEL.
Fat acids	94.811	93.692
Lime	5.189	6.308
Corresponding with—		
Free fat acids	46.271	32.832
Lime-soap	53.729	67.168

SPECIMEN 2.—*Lime-soap.*

Fat acids	94.107	93.703
Lime	5.892	6.297
Corresponding with—		
Free fat acids	38.991	33.02
Lime-soap	61.009	66.98

SPECIMEN 3.

Fat acids	94.68	94.475
Lime	5.32	5.525
Corresponding with—		
Free fat acids	44.92	41.33
Lime-soap	55.08	58.67

As the results of the investigation so made by me, pursuant to the said order, and based upon the testimony which I have taken, and which is herewith filed, I do hereby report to the court, in answer to the order upon me, "to ascertain with what percentage of lime defendant is actually working," that the defendant at the date of said order was working with something less (7) seven per cent. of lime.

329 Second. In the said order it is further directed that I, as such master, shall institute such examination of the defendant's apparatus and mode of working as will enable me to ascertain "whether it is possible to operate his present apparatus without infringing upon complainant's patent."

In order to arrive at a satisfactory conclusion as to the matter involved in this part of the order of the court, I have found it necessary to refer to and examine carefully the opinion of the court in the cause, as delivered by his honor, Judge Leavitt, at the special term held in February, A. D. 1862.

In that opinion the following language occurs:

"It is contended, and the evidence proves it, that the defendant uses two distinct agents in his process; he has superheated water, and in addition uses six or seven pounds of lime to each one hundred pounds of the fatty mass in the tank.

"The result of this, as appears satisfactorily from the evidence, is, that a part of this mass is converted into free fat acid, and a part is saponified, or converted into what some of the experts designate as an acid lime-soap. There seems to be no question that the production of free fat acid is due solely to the decomposing power of the heated water, and the saponifying effect to the alkaline properties of the lime acting on the mass of the fat.

"As to the first of these effects, the production of free fat acids, the precise principle which constitutes the distinguishing feature of the plaintiff's invention, is clearly brought into requisition in the process."

Such being the decision of the court, it is obvious that, in order not to infringe upon complainant's patent, the defendant must so work his apparatus as to avoid the production in his tank of free fat acid, or, stating the proposition affirmatively, the defendant must so work as to produce a perfect saponification or neutralization of the fat treated in his apparatus. What quantity or percentage of lime is necessary to produce this perfect saponification is the next inquiry.

330 In the determination of this, I found it necessary to examine the testimony that was offered at the trial of the cause, and also the testimony taken in another branch of the case now pending before me; the result of such examination satisfied me that it requires not less than 11½ pounds of lime, such as used in commerce, for each 100 pounds of fatty matter, in order to produce perfect saponification, or avoid the production of free fat acid. Acting upon this belief, I caused an experiment to be made at the defendant's manufactory, after notice to him and with his consent, in order to ascertain the practicability or impracticability of operating his present apparatus with 11½ pounds of commercial lime for each 100 pounds of fat treated.

Such experiment was conducted in the presence of Messrs. Wayne and Fennel, the defendant Werk, his copartner Kirby and others. The experiment being completed, I caused an analysis of the product to be made by Wayne and Fennel, the result of which is stated in their testimony herewith filed. According to the testimony and analysis of Mr. Wayne, there was a complete chemical combination of the fat and lime, producing as it is called "neutral lime-soap," showing that 11½ pounds of lime, of the quality as used here, is the exact quantity necessary to avoid the production by the defendant in his apparatus of "free fat acid."

According to the statement and analysis of Mr. Fennel, there was a slight excess of lime, being something less than one-fifth of one per cent., an excess "hardly perceptible," as stated by Mr. Fennel.

Assuming that the analysis of Mr. Fennel is correct, and that the defendant can use a fraction less than 11½ pounds of lime to 100 pounds of fat without infringing the complainant's patent, it only remains to

be ascertained, whether his apparatus can be operated with the use of such quantity of lime.

The witness', Wayne and Fennel, testify that the result of the experiment with 11½ pounds of lime demonst'ated that it is wholly im-
331 practicable to operate defendant's apparatus with that quantity of lime. In that experiment, the quantity of fat treated was 4,000 pounds, which is some 3,000 pounds less than the ordinary charge. These witnesses further testify that the difficulties of the operation would be greatly increased if the quantity of fat was increased to 7,000 pounds. It is fair to assume, therefore, that the conditions under which the experiment was performed were quite as favorable to the defendant as they would have been if the quantity of fat had been increased to the ordinary working quantity, 7,000 pounds, and the quantity of lime diminished by one-fifth of one per cent.

As the result of the experiments and investigations so made by me, pursuant to the said order, and based upon the testimony which I have taken, and which is herewith filed, I do hereby report to the court, in answer to the order upon me, "to ascertain whether it is possible to operate defendant's present apparatus without infringing upon complainant's patent," that in my judgment it is not practicable for the defendant to work his present apparatus with the use of such quantity of lime as is necessary to avoid the production of "free fat acid," and considering it to have been expressly decided by the court, that the production of "free fat acid," by the defendant, was an infringement upon complainant's patent, my opinion is, and I do so report, that the use by defendant of his present apparatus, so as not to infringe complainant's patent, is not practicable.

332 EXHIBIT F.

[Stamp.]

Memorandum of an agreement made the 29th day of July, A. D. 1865, between Richard A. Tilghman, of Philadelphia, of the one part, and M. Werk & Co., of Cincinnati, manufacturers of soap and candles, of the other part.

Whereas letters-patent of the United States have been granted to said Tilghman for an improved process of purifying fatty bodies, dated October 3, 1854; and whereas said firm of M. Werk & Co. have partially employed said process in their business, and now desire to pay for such past partial use of said process, and also to continue such partial use under the license of the said Tilghman for the remaining unexpired time of said patent: Now, this agreement witnesseth that said M. Werk & Co. will pay the said Tilghman the sum of fourteen thousand dollars in cash, and will also pay the costs as ordered by the decree of the United States circuit court of this district, in the case of Tilghman vs. Werk in consideration of which payments said Tilghman hereby agrees to release said M. Werk & Co. from all further claim or liability on account of their past use of said patent, and also licenses them to continue the partial use of said patent, for all the fat treated by them in their factory in Cincinnati, until the 9th day of January, 1868, which is the day of the expiration of the said patent.

It is hereby distinctly understood and agreed that this license for the future partial use of said patent does not authorize the said Werk & Co., to employ less than seven pounds of best commercial lime to each

one hundred pounds of fat treated by them in their digesters or tanks for the manufacture of fat acids.

And they agree to keep an account of the quantities of fat, if any, so treated by them, with less than 7 per cent. of lime, and to report
333 the same monthly to said Tilghman, and at the same time to make an additional payment to him monthly for the same, at the ollowing rate, for each one hundred pounds of fat so treated:

If six per cent. of lime is used	$1\frac{42}{100}$	cents.
" five " " " "	$2\frac{84}{100}$	"
" four " " " "	$4\frac{26}{100}$	"
" three " " " "	$5\frac{68}{100}$	"
" two per cent. or less,	10	"

In witness thereof the parties have hereunto set their hand and seals, at Cincinnati, on the date above mentioned.

(Signed) R. A. TILGHMAN, [SEAL.]
M. WERK & CO., [SEAL.]

Witness:
G. WERK.

[Stamp.]

Cincinnati, July 29, 1865, received of M. Werk & Co., fourteen thousand dollars, in cash, as specified in the above agreement.

(Signed) R. A. TILGHMAN.

EXHIBIT G.

1123 SPRUCE STREET,
Philadelphia, December 30, 1867

M. WERK & CO., *Cincinnati:*

GENTLEMEN: My patent, dated October 3, 1854, No. 11766, has bee extended for seven years, commencing 9th January, 1868. Our agreement of license, dated 29th July, 1865, relates only to the original term of the patent, expiring 9th January, 1868. If you desire to use the process after that date, a new agreement of license will be necessary.
334 In all permanent licenses, under the extended patent, I intend having but one rate of license, viz., twenty cents per hundred pounds of fat treated, irrespective of the proportion of lime used. But as your present apparatus is probably not well adapted to working with very small quantities of lime, I am willing that, until 1st August, 1868, your rate shall be proportionate to the percentage of lime you use. After the 1st August, 1868, the rate to be 20 cents per 100 pounds fat treated. This will give time for providing before the next season, (should you desire it,) an apparatus suitable for working with one-half per cent. of lime or less. I enclose duplicate copies of an agreement to the above effect, which, if you think proper, you can sign and send to me, and I will sign and return one to you. I propose to furnish printed forms for the monthly statements. In case you do not think proper to accept the above proposition, you will please consider this as notice to desist from using my patented process after the 9th January, 1868.

Very truly yours,
(Signed) R. A. TILGHMAN.

be ascertained, whether his apparatus can be operated with the use of such quantity of lime.

The witness', Wayne and Fennel, testify that the result of the experiment with 11½ pounds of lime demonst'ated that it is wholly im-
331 practicable to operate defendant's apparatus with that quantity of lime. In that experiment, the quantity of fat treated was 4,000 pounds, which is some 3,000 pounds less than the ordinary charge. These witnesses further testify that the difficulties of the operation would be greatly increased if the quantity of fat was increased to 7,000 pounds. It is fair to assume, therefore, that the conditions under which the experiment was performed were quite as favorable to the defendant as they would have been if the quantity of fat had been increased to the ordinary working quantity, 7,000 pounds, and the quantity of lime diminished by one-fifth of one per cent.

As the result of the experiments and investigations so made by me, pursuant to the said order, and based upon the testimony which I have taken, and which is herewith filed, I do hereby report to the court, in answer to the order upon me, "to ascertain whether it is possible to operate defendant's present apparatus without infringing upon complainant's patent," that in my judgment it is not practicable for the defendant to work his present apparatus with the use of such quantity of lime as is necessary to avoid the production of "free fat acid," and considering it to have been expressly decided by the court, that the production of "free fat acid," by the defendant, was an infringement upon complainant's patent, my opinion is, and I do so report, that the use by defendant of his present apparatus, so as not to infringe complainant's patent, is not practicable.

332 EXHIBIT F.

[Stamp.]

Memorandum of an agreement made the 29th day of July, A. D. 1865, between Richard A. Tilghman, of Philadelphia, of the one part, and M. Werk & Co., of Cincinnati, manufacturers of soap and candles, of the other part.

Whereas letters-patent of the United States have been granted to said Tilghman for an improved process of purifying fatty bodies, dated October 3, 1854; and whereas said firm of M. Werk & Co. have partially employed said process in their business, and now desire to pay for such past partial use of said process, and also to continue such partial use under the license of the said Tilghman for the remaining unexpired time of said patent: Now, this agreement witnesseth that said M. Werk & Co. will pay the said Tilghman the sum of fourteen thousand dollars in cash, and will also pay the costs as ordered by the decree of the United States circuit court of this district, in the case of Tilghman vs. Werk in consideration of which payments said Tilghman hereby agrees to release said M. Werk & Co. from all further claim or liability on account of their past use of said patent, and also licenses them to continue the partial use of said patent, for all the fat treated by them in their factory in Cincinnati, until the 9th day of January, 1868, which is the day of the expiration of the said patent.

It is hereby distinctly understood and agreed that this license for the future partial use of said patent does not authorize the said Werk & Co., to employ less than seven pounds of best commercial lime to each

one hundred pounds of fat treated by them in their digesters or tanks for the manufacture of fat acids.

And they agree to keep an account of the quantities of fat, if any, so treated by them, with less than 7 per cent. of lime, and to report
333 the same monthly to said Tilghman, and at the same time to make an additional payment to him monthly for the same, at the following rate, for each one hundred pounds of fat so treated:

If six per cent. of lime is used	$1\frac{42}{100}$	cents.
" five " " " "	$2\frac{84}{100}$	"
" four " " " "	$4\frac{26}{100}$	"
" three " " " "	$5\frac{68}{100}$	"
" two per cent. or less,	10	"

In witness thereof the parties have hereunto set their hand and seals, at Cincinnati, on the date above mentioned.

(Signed) R. A. TILGHMAN, [SEAL.]
M. WERK & CO., [SEAL.]

Witness:
G. WERK.

[Stamp.]

Cincinnati, July 29, 1865, received of M. Werk & Co., fourteen thousand dollars, in cash, as specified in the above agreement.

(Signed) R. A. TILGHMAN.

EXHIBIT G.

1123 SPRUCE STREET,
Philadelphia, December 30, 1867

M. WERK & CO., *Cincinnati:*

GENTLEMEN: My patent, dated October 3, 1854, No. 11766, has bee extended for seven years, commencing 9th January, 1868. Our agreement of license, dated 29th July, 1865, relates only to the original term of the patent, expiring 9th January, 1868. If you desire to use the process after that date, a new agreement of license will be necessary.
334 In all permanent licenses, under the extended patent, I intend having but one rate of license, viz., twenty cents per hundred pounds of fat treated, irrespective of the proportion of lime used. But as your present apparatus is probably not well adapted to working with very small quantities of lime, I am willing that, until 1st August, 1868, your rate shall be proportionate to the percentage of lime you use. After the 1st August, 1868, the rate to be 20 cents per 100 pounds fat treated. This will give time for providing before the next season, (should you desire it,) an apparatus suitable for working with one-half per cent. of lime or less. I enclose duplicate copies of an agreement to the above effect, which, if you think proper, you can sign and send to me, and I will sign and return one to you. I propose to furnish printed forms for the monthly statements. In case you do not think proper to accept the above proposition, you will please consider this as notice to desist from using my patented process after the 9th January, 1868.

Very truly yours,
(Signed) R. A. TILGHMAN.

EXHIBIT H.

1123 SPRUCE STREET,
Philadelphia, January 23, 1868.

M. WERK & COMPANY, *Cincinnati:*

GENTLEMEN: On the 30th December, 1867, I wrote to you, stating that my patent, No. 11766, had been extended, and offering a license to use it upon certain terms.

I have as yet received no answer from you, and am informed that you continue working in the same way as you did under my
335 license (now expired) prior to January 9, 1868. I now beg to inform you that, in case I do not hear from you on the subject within ten days from this date, or am not reliably assured that you have ceased working in the way you worked before January 9, 1868, I shall immediately commence legal proceedings against you.

Your obedient servant,
(Signed) R. A. TILGHMAN.

Circuit court of the United States in and for the southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz. } No. 1018. In equity.

The joint and several answers of Michael Werk, Thomas Kirby, John Kirby, and M. Schwartz, defendants to the bill of complaint of Richard A. Tilghman, complainant.

These defendants now, and all times hereafter, saving and reserving to themselves, and each of them, all and all manner of benefit and advantage of exceptions that can or may be had or taken to the many errors, insufficiencies, and imperfections in the said bill of complaint contained, for answer thereto, or to so much thereof as they are advised it is material or necessary for them to answer unto, say as follows, to wit:

That they are informed and believe that said complainant did obtain letters-patent of the United States, (bearing date October 3d, 1854,) for fourteen years from the ninth day of January, A. D. 1854, entitled, Improvement in processes for purifying fatty bodies, which improvement he alleged had been invented by him; but that the said
336 Richard A. Tilghman was the original, true, and first inventor or discoverer of the said alleged improvement or thing patented to him as aforesaid, these defendants here, as more particularly hereinafter, deny. And they are advised and believe, and therefore aver, that the drawings accompanying the description or specification annexed to said letters-patent, and so much of said description or specification as refers to said drawings, are not part or parts of the alleged improvement, invention, or thing patented, or intended to be patented therein or thereby.

And these defendants, further answering, say that they are informed and believe that, on or about the 15th day of March, A. D. 1867, the said complainant made application in writing to the Commissioner of Patents, praying for an extension of the said letters-patent; and that the Commissioner of Patents did, on the 23d day of November, 1867, decide

that said patent ought to be extended, and did, on said 23d day of November, 1867, endorse a renewal thereof; but they are advised and believe, and therefore aver, that the said Commissioner of Patents, on said 23d day of November, 1867, had no jurisdiction over the subject-matter, and had no power and authority to decide that question: and that, for want of jurisdiction, the action of said Commissioner of Patents in the premises is void and of no validity. And they are advised and believe, and therefore aver, that said application was not made in conformity with the requirements of the then existing laws of Congress; and that the proceedings had upon said application were not conformable to law, and that the requirements of said acts of Congress were disregarded, evaded, and violated, both by said complainant and by the then Commissioner of Patents, as hereinafter more particularly set forth. Wherefore these defendants aver that the extension of said letters-patent, as set forth in said bill of complaint, was granted without authority in law, and obtained by fraudulent and deceptive proceedings as against the public, and by collusion between the said complainant and the said Commissioner of Patents, and is therefore null and void.

337 And these defendants, upon information and belief, specify the following as amongst other particulars of said fraudulent, evasive, and collusive proceedings upon said application for said extension, to wit: That notice of said application, and of the time and place when and where the same would be considered, was not published as required by law, but that, in order to conceal and prevent public notice or information of such application, notice thereof was caused to be published only in Washington City, and in one obscure paper in the city of Philadelphia, Pennsylvania, where there was no interest adverse to said extension; that said Tilghman did not furnish to the Commissioner of Patents a true and faithful account of loss and profit in any manner accruing to him from and by reason of said alleged invention; that the pretended account of such loss and profit filed in connection with said application was not true and faithful; that said account fails to disclose the receipts of large sums of money by said Tilghman, on account or by reason of his said alleged invention, and in other respects falls short of the requirements of said acts of Congress in such case made and provided; that these defendants and others of the public were desirous of opposing such application for extension, and, in due season for the proper filing of said application, had made arrangements for such opposition, but were surprised at learning that said letters-patent had already been extended upon an application filed nearly ten months before the expiration of said patent; that proceedings by any person to show cause why such extension should not be granted were thus fraudulently precluded; that such proceedings were instituted as soon as information was obtained of such application, and long before the expiration of said letters-patent, under delusive inducements thereto given by the said Commissioner of Patents; but, although testimony was taken in such proceedings under notice to said complainant, and in his presence, or in the presence of his counsel, and the witnesses produced by the said opponents, cross examined by or in behalf of said Tilghman, and a pretended but deceptive agreement made

338 by said Tilghman that the said testimony might be used upon said application, yet, in fact, said letters-patent had been extended before the public adversely interested had notice thereof; and the proceedings in opposition thereto were not only futile, but deceptive; and the testimony submitted by said opponents, though filed in the United States Patent Office, was never considered by the Commissioner

of Patents, but remained unopened, and still remains, or very recently was on the files of the Patent Office unopened; and these defendants refer to said testimony and to the examiner's report in this connection; wherefore these defendants insist that the public was fraudulently and collusively debarred from opposing such application by the said Commissioner of Patents and said Tilghman.

And, further answering, these defendants say that it is true that the said Richard A. Tilghman did commence a suit in the circuit court of the United States for the southern district of Ohio against the said Michael Werk, one of the defendants herein, and they admit that an interlocutory decision was made in favor of the complainant therein, but they deny that said cause came to a final hearing, or that it was ordered, adjudged, or decreed that the said Richard A. Tilghman was the original inventor of the invention patented to him. They admit that a reference thereof was made to Charles B. Collier, esq., named in said bill of complaint, to compute and ascertain the damages which the complainant was entitled to recover of the defendant, and they admit the subsequent proceedings and report of said master as set out in said bill.

And, further answering, these defendants say that said suit was brought to a hearing, and said interlocutory decision given without a full or complete presentation to the court of the state of the art bearing upon the branch of manufacture to which the said letters-patent relate; that the report referred to in said bill was not a final report, and that pending the hearing and determination of the matters referred to said master, a compromise and settlement of said cause was effected between said complainant and said Werk, and a report of such fact made by said master to the court; (but they deny that the com-
339 promise in said bill mentioned was effected while the motion for an attachment against the said defendant was pending;) that the court being advised that the matters in controversy in said suit had been settled and adjusted by the parties, the court ordered that the suit be dismissed without record; and the defendants herein do accordingly submit and insist that they are not, nor is either of them, bound by or determined by the said suit or proceedings, or anything therein decided or done, and in this connection they crave leave to refer to the files of this honorable court.

And these defendants, further answering, deny that said defendant Michael Werk received from said complainant a license to manufacture free fat acids, according to the process patented to said complainant, and they refer to the exhibit annexed to said bill, and marked F in this connection.

And these defendants, further answering, say as to the suit mentioned in said bill of complaint against Roland G. Mitchell of New York, they are informed and believe that said suit was commenced and brought to a final hearing as stated in said bill, and that it was decreed therein that the complainant's said letters-patent were good and valid, and that said Tilghman was the original and first inventor of the improvement described and claimed in said patent, as in said bill alleged; but these defendants, further answering, say that they are informed and believe the process used by said Mitchell, and upon which said suit was founded, was a substantially different process from that used by these defendants, and one in which no lime or other alkali was employed; wherefore said suit, and the result thereof, so far as affects the question of infringement herein involved, is irrelevant and immaterial.

And, further answering, the defendants say they do not admit that the said complainant has extensively applied the said alleged improvement to practical use, as alleged in his said bill of complaint. On the contrary, they are informed and believe, and therefore aver, that the complainant, and others under his direction, have attempted to manufacture free fat acids and glycerine by the action of water at a high temperature and pressure, according to the mode and form
340 of apparatus described in his said letters-patent, and that all such attempts have totally failed of success, and been abandoned after the expenditure of large sums of money by those making such experiments.

And as to the granting of licenses, by said complainant, to the commercial firms and the corporations named in his said bill of complaint, and the terms and conditions of such licenses, these defendants have no knowledge other than as derived from said bill, and they leave the complainant to make proof thereof as he may be advised. But the defendants are informed and believe, and therefore aver, that neither under the original or extended term of said letters-patent, nor at any time, have said alleged licensees, or either of them, manufactured free fat acids and solution of glycerine, according to the mode or in the manner described and claimed in the said letters-patent.

And these defendants, further answering, say that the two letters, of which Exhibits "H" and "G" annexed to said bill purport to be copies, were received by them; but whether the said letters and the license therein referred to do or do not embody substantially the same terms and conditions as those accepted by the parties named in the said bill as licensees of the complainant, these defendants do not know, save and except from said bill, and they leave the complainant to make proof thereof as he may be advised. And the defendants state that, not employing, or desiring to employ the process patented to the complainant, and believing, after investigation, that said patent was void, no notice was taken by the defendants to the said letters or of the threat of suit therein contained.

And, futher answering, the defendants deny that they "have used, and continue to use, the said patented improvement since the 9th day of January, 1868," or that they "are now constructing and using the said patented improvement in some parts thereof, substantially the same in construction and operation as in the said letters-patent mentioned," or that "they intend to still continue to make and use the said improvement," as alleged in said bill of complaint.

341 And the defendants state that, in the following particulars, among others, the process employed by the defendants since the 9th day of January, 1868, and up to about the 15th day of June, 1868, when they suspended operations, differs from that described and claimed in the complainant's said letters-patent, to wit:

COMPLAINANT'S PATENT.	DEFENDANTS' PROCESS
"I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine."	Consists of two distinct operations: 1st. The fat is subjected to the action of milk of lime, steam heat at a low pressure, and sand, in a closed tank; 2d. The product of this treatment is an acid lime-soap, which must be subjected to the action of sulphuric acid, without which second process it could not be used for candle-stock.

"I mix the fatty body to be operated upon with from a third to half its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting-point of lead (612° F.) until the operation is complete."

Fatty body mixed with milk of lime, and heated by an application of steam heat to 300° F. The operation is not completed until the mixture has been drawn off into a separate tank, and treated with sulphuric acid.

"The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam."

The vessel is so closed as to contain steam, and steam is, during the process, actively circulating in the vessel and through and above the mixture in large quantities.

"No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture."

The vessel only filled with the mixture to about three-fourths of its capacity, steam occupying all the rest of the space in the tank. If the vessel was kept entirely full of the mixture, the operation would entirely fail.

* * * "The mixture while flowing through them (the tubes) should be maintained at the desired temperature for ten minutes before it passes into the refrigerators."

The mixture is subjected in one mass to the desired temperature for six hours, and then allowed to stand from twelve to fifteen hours in the digester; no refrigerators employed, nor tubes, for any purpose other than the induction of the steam.

342 "The melting-point of lead (612°) has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matters into fat acid and glycerine takes place with some materials (such as palm oil) at or below the melting-point of bismuth (510°.)

The maximum heat employed for the treatment of the hardest fats, such as tallow, by defendants (300° F.,) is 140° F. less than the minimum mentioned in the patent (440° F.) for vegetable fats or oils.

"To indicate the temperature, I have found the successive melting of metals, etc., to be convenient in practice.

"The series I have used consist of tin melting at about 440° F.; bismuth at about 510°; lead at about 612° F.; and nitrate of potash at about 660° F."

"I deem it prudent to test the strength of the apparatus by a pressure of 10,000 lbs. to the square inch, before taking it into use; but I believe that the working pressure necessary in using the heat I have mentioned, will not be found to exceed 2,000 lbs. to the square inch."

The apparatus of defendants is subjected to a pressure due to a temperature of about 300° F., which is about 75 lbs. to the square inch, or 1,925 lbs. to the square inch less than the "working pressure," according to the directions of the patent.

"The hot mixture of fat acids and solution of glycerine which escapes from the exit valve of the apparatus separates by subsidence. The fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means. The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soaps, etc."

None of the mixture escapes from defendant's apparatus. It does not and cannot separate into fat acid and solution of glycerine by subsidence, and could not be used in the manufacture of candles and soaps, etc., in the state in which it is removed from the tank, because it is an acid lime-soap.

343 "Some fatty bodies, (particularly when impure,) generate during the process a portion of acetic or other soluble acid, which might tend to injure the iron tubes: in such cases I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes."

"Having now described the nature of my said invention, and the manner of performing the same, I hereby declare that I claim as of my invention, the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure."

The defendant's have not manufactured fat acids and solution of glycerine by the action of water at a high temperature and pressure, but have manufactured acid lime-soap, but no free fat acid, by the combined action of milk of lime, steam heat and pressure, and sand; they have not used lime, or other alkali, for the purpose stated in the patent, but for the express and sole purpose of decomposing the fat, the decomposing power of the lime being enhanced by the action of the steam.

To the several interrogatories propounded to them in the complainant's bill of complaint, the defendants answer as follows, to wit:

1. On information and belief they say said original letters were granted to the said Richard A. Tilghman.

2. They say, on information and belief, that an endorsement of extension of said letters patent was made thereon by the Commissioner of Patents on the 23d day of November, 1867, but they allege that such extension, for reasons hereinbefore given, and now referred to, was and is null and void.

3. The defendants, since the 9th day of January, 1868, have not manufactured any fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure; but they have manufactured fat acids by subjecting fatty bodies to two distinct and independent operations—the first consisting in subjecting such fatty bodies to the combined action of milk of lime, steam heat and pressure, and sand, in a receiver or digester; the second consisting in subjecting the product of the first operation to the action of sulphuric acid.

344 4. The process as employed by the defendants, as hereinafter set forth, since the 9th day of January, A. D. 1868, and up to about the 15th day of June, 1868, is as follows, to wit:

Into a closed cylindrical wooden digester, cased with iron, a charge of about 7,000 pounds of neutral fat is introduced through a man-hole in the top of the digester: a milk of lime, composed of about 2,400 pounds of water, and about 490 pounds (or seven per cent.) of lime, is added to the said charge of fat; the man-hole is then closed, and superheated steam introduced through a perforated coil of pipe in the bottom of the tank or digester from a steam-generating boiler, with which the coil is connected by a steam-pipe. The digester, when charged as above, is about three-fourths full of the mixture. The introduction of this steam is continued for about six hours, by which time the temperature of the contents of the digester has been gradually raised to about 300° F., when the steam is shut off, and a quantity of sand, about 300 to 450 pounds, is introduced into the digester, and the contents are then allowed to stand for about 12 to 15 hours, which completes the first stage of the process. The watery product of this process is then drawn off, and the other product, to wit, the acid lime-soap, taken out of the digester through a discharge cock, and washed in a tank with about 980 pounds of sulphuric acid, which combines with the lime, and sets the fat acids free.

During the continuance of the treatment in the digester, the mixture is stirred continually by an agitator for the purpose of accelerating and

state of the art, to the following letters-patent and publications, to wit:

14. Des machines et Procédés specifiés dans les brevéts d'invention, de perfectionement et d'importation don't la durée est expirée * * Tome XV.—A Paris * * * 1828, page 305 1424.
24th April, 1823.

Patent of invention of five years, for a new method of melting tallow in close vessels, to Mr. Appert, of Paris.

15. English letters-patent of Nicholas H. Manicler, dated March 20, 1826, No. 5345.

16. Engineers and Mechanics' Encyclopedia, 2 vols. London, 1835. Tho's Kelly, publisher. Vol. 1, page 308. Title, "Candles."

17. English letters-patent of David Walther, dated December 23, 1840. No. 8752.

18. Journal of the Franklin Institute of the State of Pennsylvania, for the promotion of the mechanic arts, February, 1848, (pages 142, 143, 144, and 145 of vol. 15, third series.) Article "On the decomposing power of water at high temperatures," by Richard A. Tilghman, read before the American Philosophical Society, Philadelphia, August 20, 1847.

349 And these defendants, further answering, say that the said alleged invention, specified in said letters-patent granted to said complainant, was, or substantial and material parts thereof were, long prior to the pretended invention thereof by said complainant, and more than two years before his application for said letters-patent, described in the above-named public works.

And the defendants state, on information and belief, that, upon the questions of novelty, originality, and the prior state of the art, as affecting the validity of said letters-patent of the complainant, and the question of infringement, the publications and patents hereinbefore referred to, except those numbered respectively five (5) and eight (8) were not cited or offered in evidence by the said Michael Werk in the aforesaid suit prosecuted against him, and the same were not known to the court, as the defendants are informed and believe, at the time the said decree was made, and they are advised and believe, and therefore aver, that such evidence would have materially affected the decree in said suit.

And these defendants, further answering, deny that they have, since the ninth day of January, 1868, infringed upon the said letters-patent of the complainant, or upon any rights that are secured to him thereby, or that may lawfully be claimed by him under or by virtue thereof, and they submit to this honorable court that, in view of the state of the art to which said letters-patent pertain, as hereinbefore referred to, they have good and lawful right to use the process hereinbefore described as employed by them, the same being, as these defendants believe and aver, a far superior process to that described in said letters-patent, and differing therefrom in principle, in mode of operation, and in effect produced.

And the defendants, having now fully answered all of said bill of complaint which they are advised it is material or necessary to make answr unto, do now deny the right of the complainant to the relief, or any part thereof, as prayed in his said bill, and they do pray to

350 be hence dismissed with their reasonable costs and charges in this behalf most wrongfully sustained.

M. WERK.
M. SCHWARTZ.

BALDWIN & COLLIER,
Sol'c'rs for Defendants.
C. D. COFFIN,
Of Counsel.

UNITED STATES OF AMERICA,
Southern District of Ohio, Hamilton County, ss:

Before the subscriber, a notary public in and for said Hamilton County, in said district, on this first day of August, A. D. 1868, personally appeared Michael Werk and M. Schwartz, defendants in the foregoing answer named, and by whom the same is subscribed respectively, who, being by me severally duly sworn according to law, depose and say that they have read the foregoing answer and know the contents thereof, and that the statements therein contained, so far as within their knowledge, are true, and so far as they are derived from information, they verily believe them to be true.

Sworn to before me, and subscribed in my presence, this first day of August, A. D. 1868.

[SEAL.]

L. H. PUMMILL,
Notary Public, Hamilton County, Ohio.

351 Circuit court of the United States, southern district of Ohio. In chancery.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz. } No. 1018.

These defendants, by leave of the court first had and obtained, come and file a supplemental and additional answer to the bill of complaint of said Tilghman. And these defendants, by way of additional answer, jointly and severally, say that they do not waive any of the matters heretofore in their original answer set forth, but still insisting upon all and every matter therein set forth, as fully as if herein again set forth, further answering, say: That, after having experimented after the 15th day of June, 1868, as set forth in their original answer, they have discontinued the use of the process before then employed by them in the manufacture of fat acids, fully described in their said original answer, and have adopted a new process, and began manufacturing with their new process on or about the , which process is described as follows: Into an iron cylindrical tank or digester, lined or cased with wood, capable of containing about 32,000 pounds of water, (the tank being about 16 feet high and about 7 feet diameter,) there is introduced tallow to about one-half of the capacity of the digester;

352 to this milk of lime is added, to about one-fourth the capacity of the digester, such milk of lime containing about four pounds of lime to each one hundred pounds of tallow. The digester has near its lower end, entering it, a steam-pipe; after entering the digester this steam-pipe bends upwards near the inner wall of the digester, and extends about two-thirds the height of the digester, when it bends again and extends downwards, until it reaches nearly to the bottom of the di-

gester, when it again bends and runs horizontally to the centre of the digester, where it bends upwards again and enters another pipe of larger diameter, which latter pipe is attached by braces to the bottom of the digester at its under lining. This last-referred-to pipe is about ten feet in length, open at both ends, and so secured as not to rest on the bottom of the digester. The steam-conducting pipe first described has two outwardly opening valves, one near the most elevated part of the pipe, and one at its end, within the large pipe above described. The digester has also, on its top, another pipe leading to a revolving condensor, such pipe being supplied with a valve. After the material to be treated has been placed in the digester, the tank is closed, excepting the pipe at the top, on which is the valve above mentioned. Superheated steam is then introduced through the conducting-pipe first described; this steam escaping through the valve at the end of the pipe presses upward the material in the centre pipe above it in the digester, the lower part of the large or centre pipe being open, other material rushes in, and, passing up through the larger pipe, is brought under the influence of the current of steam, and this operation is continued, an intimate mixing or stirring up of the materials being thus effected for the space of eight or ten hours, during all which time there is a constant outflow of steam through a valve in the pipe on the top of the digester, which valve is weighted so as to resist a pressure of from three to six atmospheres. This escaping steam is condensed, and the glycerine-water arising from such condensation is then drawn off for condensation. The remaining product of the digester after the conclusion of the operation, is in part water containing a solution of glycerine, which is drawn off for concentration in the usual manner, and in part acid lime-soap, which is
353 then removed from the digester and placed together with water and sulphuric acid in a tub, where it is boiled by the introduction of steam, after which the fat acid becomes free and fit for use, through the decomposition of the acid lime-soap.

And the defendants say that the process so employed by them differs wholly from the process of the plaintiff, and in no manner infringes the said letters-patent of the plaintiff; and these defendants deny that they have, since the 9th day of January, 1868, used in any manner the patented improvement of the plaintiff, and deny that they are now using the said patented improvement, or any part thereof, but they and each and every of them aver that, in view of the state of the art to which said letters patent pertain, as herein and in their original answer referred to, they have a right to use the process which they used between the 8th day of January, 1868, and the 15th of June, 1868, and also the process used by them since the 15th of June, 1868, and herein fully described; and that the process herein described, as well as that set forth in their original answer, differs essentially in principle, in mode of operation and in effect, from that patented to the plaintiff, as will clearly appear by a comparison of the plaintiff's process and the process now used by the defendants, viz:

PLAINTIFF'S PATENT.	DEFENDANTS' PROCESS
"I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of these bodies to combine with water, and thereby obtain at the same time free fat acids and a solution of glycerine."	Consists of two distinct operations: 1st. The fat is subjected to the action of milk of lime, steam-heat at a low pressure in a closed tank; 2d. The product of this treatment is an acid lime-soap which must be subjected to the action of sulphuric acid; without such second process it could not be used for candle-stock. Fatty body mixed with the milk of lime, and heated by an application of steam-heat to about 310° F.

"I mix the fatty body to be operated upon with from a third to half its bulk in water, and the mixture might be placed in any convenient vessel in which it can be heated to the melting-point of lead, (612° F.,) until the operation is complete."

The operation is not completed until the mixture has been drawn off into a separate tank and treated with sulphuric acid.

354 "The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam."

The vessel is so closed as to contain steam, and steam is, during the process, actively circulating in the vessel, and through and above the mixture in large quantities.

"No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture."

The vessel is only filled with the mixture about three-fourths of its capacity, steam occupying all the rest of the space in the tank; if the tank was kept entirely full the operation would fail.

"The mixture, while flowing through them, (the tubes,) should be maintained at the desired temperature for ten minutes before it passes into the refrigerators."

The mixture is subjected in one mass to the desired temperature for eight or ten hours, and then allowed to stand from eight to twenty-four hours in the digester; no refrigerator employed, nor tubes for any purpose other than the induction and outlet of steam.

"The melting-point of lead (612° F.) has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matter into fat acid and glycerine, takes place with some material, (such as palm-oil,) at or below the melting-point of bismuth (510° F.)

The maximum heat employed for the treatment of the hardest fats, such as tallow 320° F., is 130° F. less than the minimum mentioned in the plaintiff's patent (440° F.) for vegetable oils or fats.

"To indicate the temperature, I have found the successive melting of metals, etc.: to be convenient in practice. The series I have used consist of tin, melting at 440° F.; bismuth at about 510°; lead at about 612°; and nitrate of potash at about 660° F."

355 "I deem it prudent to test the strength of the apparatus by a pressure of 10,000 lbs. to the square inch, before taking it into use, but I believe that the working pressure necessary in using the heat I have mentioned will not be found to exceed 2,000 lbs. to the square inch."

The apparatus of the defendant's is subjected to a pressure due to a temperature of about 310° F., which is about 85 pounds to the square inch, or 1,915 pounds less to the square inch than the "working pressure" according to the direction of the plaintiff's patent.

"The hot mixture of fat acids and solution of glycerine which escapes from the exit valve of the apparatus separates by subsidence. The fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means. The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soap, etc.

None of the mixture escapes from the defendant's apparatus. It does not and cannot separate into fat acid and solution of glycerine by subsidence, and could not be used in the manufacture of candles and soap, etc., in the state in which it is removed from the tank, nor could any part of it be so used, because it is an acid lime-soap.

"Some fatty bodies (particularly when impure) generate during the process a portion of ascetic or other soluble acid which would tend to injure the iron tubes. In such cases I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes."

The defendants have not manufactured fat acids and solution of glycerine by the action of water at a high temperature and pressure, but have manufactured acid lime-soap, but no free fat acid, by the combined action of milk of lime, steam heat and pressure. They have not used lime or other alkali for the purpose stated in the plaintiff's patent, but for the express and sole purpose of decomposing the fat, the decomposing power of the lime being enchanced by the action of the steam.

And these defendants further answering, say that, long before the time of the alleged discovery and invention of the plaintiff, as set forth in said letters patent, glycerine, in many instances, and by many manufactures, by various applications of water, steam, pressure, and
356 lime was evolved in the various processes of producing fat acids, though the value and use of glycerine were not then known as now, by such manufacturers. And the defendants further say that, prior to said alleged discovery and invention of the plaintiff, free fat acids and the solution of glycerine were manufactured and sold, and were articles of commerce, and the methods of obtaining the same, and the processes for separating the fats from glycerine were in use, and the state of the art in respect to the processes for producing free fat acids and the solution of glycerine will show that fats were then, and before then, treated by water, heat, pressure, and lime for the purposes aforesaid; and the defendants therefore submit that, if the said patent of the plaintiff is valid, which they do not admit, it must be confined and restricted to the exact and precise process therein specifically set forth of highly-heated water and pressure alone, without any aid from any other agency whatever.

And these defendants, relying upon the matters already in their original answer, and in this additional answer herein set forth, further answering, say that, prior to the time of the alleged discovery and invention of the plaintiff, the decomposing power of water under heat and pressure was known and understood; that it was well known that water under high heat and heavy pressure would, in process of time, decompose fats into acids, and it was also well known that when fats were decomposed by the action of water, glycerine was evolved, and was found in the water; it was also well known that water under heat and pressure would decompose wood fibre; and the use of close vessels and water under heat and pressure were well known and used in the decomposition of fats and many other substances; and these defendants submit and claim that the said plaintiff in his said process, as described in his patent, uses an old process before then well known and used, and therefore the said patent is invalid.

And these defendants, not waiving any matter set forth in their original answer, and in this additional answer, further answering, say that they are informed and believe, and therefore allege, that th specification of the patentee did not, and does not, contain
357 the whole truth relative to the alleged and pretended discovery and invention, and that after the said original letters-patent were issued to the said Tilghman, and before the pretended renewal and extension thereof, on said 23d of November, 1867, as alleged in the said petition, the said Tilghman became fully aware, and well knew, that the specification of his said patent did not contain the whole truth relative to the pretended discovery and invention; and at and be-

fore the renewal and extension thereof, as aforesaid, he, the said patentee, concealed that in relation to the same which he should have disclosed, and this concealment was made for the purpose of deceiving the public; and these defendants, upon the same information and belief, aver that said concealment consists in this, that, by the process of the patentee, the sole agency in his operation is highly-heated water under pressure, which, if successful at all, must require so high a heat, so heavy a pressure, and so long a time to complete the operation, as to render it unsuccessful to the manufacturer for commercial purposes, and practically useless; all of which the patentee well knew at and before the time of said renewal and extension thereof; and therefore he, in fact and in truth, makes use of lime in combination with water to effect the decomposition of the fats within a reasonable time, so as to make the operation practically successful, and does not in truth and in fact rely solely upon the chemical power of highly-heated water and pressure; and, instead of stating that he used the lime for the purpose aforesaid, and the quantity to be used, as he should have done, he concealed the real purpose for which he used the same, and permitted the statement to remain in said specification; that he uses the lime to neutralize the ascetic or other soluble acid which is generated during the process from some fatty bodies, particularly when impure, and in such cases he states that he adds a corresponding quantity of alkaline or basic matter to the water and fat before they are pumped into his tank or tubes; and this addition of alkaline or basic matter is added in a corresponding quantity to the water and fat under the pretence that this ascetic acid might tend to injure the iron tubes, when, in a previous part of his said specification he had stated that "when it is desired" to diminish the contact of
358 the liquids with iron, the tubes or channels of the apparatus may be lined with copper, and when he well knew that fat acids themselves have a tendency, in all cases to injure iron, and much more than any ascetic acid resulting merely from the impurity of any fat which could be obtained for manufacturing, and hence it is in all cases desirable to line the iron tanks and tubes with some material capable of resisting this action of fat acids.

And these defendants further say that the statement aforesaid, that some fatty bodies, particularly when impure, generate a portion of ascetic acid, which might tend to injure the tubes, &c., as set forth in said specification, is, as they are informed and believe, and therefore alleges, a false suggestion, and was intended to mislead and deceive the public, and does deceive and mislead the public, and was intended by the patentee, under the pretence aforesaid, to secure the use of alkaline or basic matter in combination with the water, to effect the decomposition of the fats in a reasonable time, and the use of the alkaline or the basic matter was not intended merely to neutralize the ascetic or other soluble acid, which is generated during the process from some fatty bodies, as stated and set forth in said specification.

And these defendants deny that the complainant is entitled to the relief sought; and, having fully answered, pray to be hence dismissed with their cost.

C. D. COFFIN,
Defendants' Solicitor, &c.

THE STATE OF OHIO,
Hamilton County, ss:

Before the undersigned authority, personally appeared Michael Werk, one of the above-named defendants, who, being by me duly sworn, says

that the matters and things set forth in the above answers, as of his own knowledge, are true, and those upon information he believes to be true.

M. WERK.

Subscribed in my presence, and sworn to before me this 30th day of November, 1868.

W. H. BALDWIN,
Notary Public.

359 Circuit court, U. S. southern district of Ohio. In equity.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz.

SIR: Please take notice that an examination of witnesses in the above cause, on the part of the complainant therein, will be had in the city of Philadelphia, on Monday, the 15th day of February, 1869, at the office of Charles B. Collier, esq., No. 713 Sansom street, before William B. Dayton, esq., a notary public in and for said city. Such examination will commence at 10 a. m., and will proceed until the examination shall be concluded.

Yours, &c.,

GEORGE HARDING,
Solicitor for Complainant.
Per B. C. TILGHMAN.

To CHARLES B. COLLIER, Esq.,
Solicitor for Defendants.

Dated, February 13th, 1869.

Service of above notice is accepted, and objections as to time are waived.

CHARLES B. COLLIER,
For Defendants.

Circuit court of the United States, in and for the southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz. } In equity.

Testimony of James C. Booth and Robert E. Rogers, taken on behalf of the complainant in the above-entitled cause, before me, William B. Dayton, special examiner, at the office of Cha's B. Collier, esq., No. 713 Sansom street, in the city of Philadelphia; such testimony having been commenced on Monday, the 15th day of February, A. D., 1869, and continued by adjournment from time to time as hereinafter noted.

MONDAY, *February 15th*—10 *a. m.*

Present, Benj. C. Tilghman, esq., on behalf of complainant; Cha's B. Collier, esq., on behalf of defendants.

JAMES C. BOOTH, being first duly cautioned and solemnly sworn, deposes and says as follows:

Q. 1. Please state your name, age, residence, and occupation.

360 A. James C. Booth; fifty-eight; reside in Philadelphia; am a manufacturing and analytical chemist, and now engaged in the refining of precious metals and preparing them for coinage.

Q. 2. With whom did you study chemistry, and where? How long have you been engaged in the profession of analytical chemist? What posts, if any, in public institutions have you held, and what works or papers have you written on chemistry?

A. I studied chemistry with Wöhler, in Cassel, Germany, and with Professor Magnus, in Berlin, during 1833, 1834, and 1835. From 1835 to the present time I have been engaged as professional analytical chemist. I was professor of chemistry applied to the arts in the Franklin Institute, Philadelphia, for ten years; and professor of chemistry and physics in the Central High School, Philadelphia; and I have been for the last eighteen years in the United States Mint, and I still continue, independently of the mint, my profession of analytical chemist. I am the author of the greater part of the Encyclopedia of Chemistry; of a report upon the progress of chemical manufactures made to the Smithsonian Institute, at the request of the perpetual secretary of that institute, Professor Henry; I also edited the translation of Regnault's Chemistry, translating much of it myself, and annotating it.

Q. 3. Are you acquainted with the various processes of manufacturing fat acids and preparing fats for manufacturing into candles? What have been your opportunities for obtaining such information?

A. I am acquainted with many of the processes referred to by reading, observation in manufacturing establishments, and my own experiments. This subject was always embraced in my lectures at the Franklin Institute.

Q. 4. Have you read, and do you understand, the letters-patent granted to R. A. Tilghman, October 3d, 1854, No. 11766?

A. I have read it and understand it.

Q. 5. Have you read, and do you understand, the answer filed by the defendants in this suit, on the first of August, 1868, as contained in the agreed printed copy now shown you, and signed by the parties' counsel hereto?

A. I have read and understand it.

Q. 6. State whether the process of defendants, as set forth in their said answer, is substantially the same or different in principle and operation from that described and claimed in complainant's patent. If defendants' process resembles complainant's in part only, state particularly how and to what extent.

361 A. The defendant's process produces a mixture of lime-soap, free fat acid, and glycerine. The lime-soap portion is produced by the chemical action of the lime on the fat. As to this portion defendant's process does not resemble complainant's. The free fat acid portion is produced by the chemical action of water at a high temperature and pressure on the fat. As to this portion, defendants' process is the same as complainant's.

Q. 7. Were you examined as a witness in the suit of Richard A. Tilghman against Michael Werk, in the circuit court of the United States for the southern district of Ohio, in 1860; and have you read, and do you understand, the answer filed by said Werk in that suit on the 6th of January, 1860?

A. I was examined as a witness in the said suit. I have read, and I

understand, the answer filed January 6, 1860, by said Werk in the said suit.

Q. 8. State whether or not the process of the defendants in this suit, as set forth in their answer filed the first of August, 1868, is substantially the same in principle and operation as the process described in the answer of Mr. Werk, filed in the suit referred to, on the 6th of January, 1860?

A. In both processes fat, lime, and water are heated in a close vessel under pressure. In both, the quantity of lime is insufficient to combine with all the fat. In both, the product is partly lime-soap, formed by the chemical action of the lime, and partly free fat acid, formed by the chemical action of the highly-heated water. The quantity of lime-soap formed is in proportion to the amount of lime used; and since, in both processes, approximately one-half of the quantity of lime is used as is used and required to make lime-soap of all the fat, in both processes approximately one-half the fat is converted into lime-soap. Both processes are substantially the same in principle and operation.

Q. 9. State what effect the addition of sand, as described in defendants' answer filed first of 1868, produces upon the chemical action taking place between the fat, lime, and water in defendants' digester.

A. The sand has no chemical action whatever. It would be entirely inert—more inert than the iron of which the digester and steam-pipes are constructed.

Q. 10. Did you analyze an alleged specimen of the product of Mr. Werk's process, as set forth in his answer filed the 6th of January, 1860? If so, give your analysis of the same.

362 A. I made such an analysis, and found that the specimen, free from glycerine, contained 58 and $\frac{27}{100}$ lime-soap and forty-one $\frac{73}{100}$ per cent. fat acids.

Q. 11. Would the product of defendants' process, as described in their answer filed 1st of August, 1868, be substantially the same or different from that analyzed by you in 1860, supposing the same proportion of lime to be used in both cases, and give your reasons?

A. In both cases, water, fat, and about seven per cent. of lime are heated in a digester to about seventy-five pounds' pressure, until all the neutral fat is decomposed. The sand is perfectly inert, and has no chemical action whatever. As the same materials are exposed to the same mode of treatment, the products will be substantially the same.

Q. 12. Have you read, and do you understand, the supplementary answer filed by defendants in this suit on first of December, 1868, as contained in the agreed printed copy now shown you, and signed by the counsel for the respective parties?

A. I have read, and I understand it.

Q. 13. Have you analyzed an alleged sample of the product of defendants' process, as set forth in their supplementary answer? If so, state when and from whom you received it, and give your analysis thereof.

A. On the 17th of December, 1868, I received at my laboratory in Philadelphia, from Adams' Express Company, a box directed to R. A. Tilghman, from Cincinnati, which I opened. It contained labeled samples of stearic and oleic acids, and of a mixture of lime-soap and fat acids. Some of the samples were labeled Werk & Co., and others Shillito. My analysis of the mixture of lime-soap and fat acids of Werk & Co. is as follows: Fat acid dissolved by alcohol, 59.70, less $1\frac{57}{100}$ lime-soap held in solution, equals 58.13 fat acid. Lime-soap left on the filter $40\frac{30}{100}$; add the $1\frac{57}{100}$ lime-soap in solution, equals 41.87 lime-soap.

Q. 14. How does that analysis agree with the proportions of fat and lime stated to be used by defendants in their supplementary answer?

A. It agrees as closely as could be expected.

Q. 15. State whether the process of defendants', as set forth in their supplementary answer filed first of December, 1868, is substantially the same or different from the process described and claimed in complainant's patent. If defendants' process resembles complainant's in
363 part only, state particularly how and in what part, and explain minutely and in detail wherein defendants' embodies the essential feature or principle of complainant's patent.

A. In defendants' process, water, fat, and a quantity of lime equal to four per cent. of the fat are heated in a close digester, under pressure. The lime combines with about four-tenths of the fat, and forms lime-soap. As to this portion of the product, defendants' process does not resemble complainant's. The other six-tenths of the fat is decomposed into free fat acid and glycerine, by the chemical action of water at a high temperature and pressure, and as to this portion of the product, defendants' process is essentially the same as complainant's.

Q. 16. State whether or not the chemical agent, in producing the fifty-eight per cent. of free fat acid found by you in defendants' product, is water at a high temperature and pressure.

(Question objected to by counsel for defendants, for form, being sug'estive of the answer sought from witness.)

A. Water at a high temperature and pressu'e is the chemical agent.

Q. 17. So far as the production of this fat acid in defendants' process is concerned, does it make any difference whether the fat and water are heated by a fire or by superheated steam, or by any other heating agent?

A. It makes no difference. Highly-heated water being the effective agent, no matter how such water is heated.

Q. 18. What is superheated steam, and how does it differ from common steam?

A. Superheated steam is steam which contains more heat, or a higher degree of heat, than is strictly necessary to retain it in a gaseous or vaporous condition. Common steam cannot be at all cooled, or have any of its heat taken away, without partly condensing into liquid water. Superheated steam, on account of its possessing an extra amount of heat beyond what is strictly necessary to retain it in a state of vapor, can lose this extra part of its heat without any of it condensing to liquid water. When superheated steam loses this extra part of its heat, it becomes common steam. Common steam, heated away from contact with water, becomes superheated steam.

Q. 19. What becomes of the superheated steam on its introduction into defendants' digester?

A. At first, while the water and fat in the digester are comparatively cool, the superheated steam will be entirely condensed into liquid
364 water, imparting all its heat—both its extra heat and its heat of vaporization to the material in the digester. When the water in the digester has been heated to a temperature corresponding to the pressure on the safety-valve of the digester, then the superheated steam will give off to the water only its extra or super degrees of heat, which will convert part of the water into steam. This steam and the superheated steam, which will now have lost its superheat and become common steam, will both escape by the safety-valve.

Q. 20. Have you made any experiments to ascertain to what extent the temperature of water will be increased proportionably to the increase of pressure; and if so, under what circumstances were these experiments made?

A. I have made such experiments. They were made in order to the

manufacture of fusible alloys employed by the United States steamboat inspectors to prevent the explosion of steam boilers. At the request of the Secretary of the Treasury, I made a series of such alloys in 1853, which represented every ten pounds' pressure above the ordinary pressure of the air up to 160 pounds' pressure. There is a correspondence between those pressures and the temperatures at which those alloys melt. The first ten pounds' pressure, above 212 degrees Fahrenheit, indicate an increase of temperature of about 20 degrees, more or less. The last ten pounds' pressure of the series, say from 150 to 160 pounds, are represented by three or four degrees' increase of temperature. The last temperature would be 360 to 370 degrees Fahrenheit.

Q. 21. In an ordinary steam-boiler are the steam and the water at the same temperature?

A. They are.

Q. 22. Please give a table from the best authorities, of the temperatures corresponding to different pressures up to 300 pounds per square inch.

Pressure in pounds.	Degrees Fahrenheit.
0°	212°
15°	250°
30°	275°
45°	293°
60°	308°
75°	320°
90°	331°
105°	341°
365 120°	350°
135°	358°
150°	367°
165°	374°
180°	380°
195°	386°
210°	392°
225°	398°
240°	403°
255°	408°
270°	413°
285°	418°
300°	422°

Q. 23. From the description of the respective processes employed by Mr. Werk in 1860, and by the defendants in this suit, in December, 1868, as set forth in their answers and from your analysis of the respective products, please explain wherein these two processes substantially resemble or differ from each other?

A. The two processes are substantially the same in the following points: In both water, fat, and lime are heated in a close digester under pressure. In both the quantity of lime is insufficient to combine with or neutralize all the fat. In both the chemical action of the lime decomposes a part of the fat and produces an equivalent quantity of lime-soap, and in both the chemical action of the water decomposes the remainder of the fat into fat acid and glycerine. The two processes differ only in the proportion of lime used and of lime-soap produced. The 1860-process uses 6 or 7 lime to 100 fat. The 1868-process uses 4 lime to the 100 fat. The 1868-process consequently ought to produce less lime-soap and more free fat acid than the process of 1860.

The analyses confirm this; for the product of 1860 contains, in round numbers, fifty-eight per cent. lime-soap and forty-two per cent. fat acids, while the product of 1868 contains forty-two lime-soap to fifty-eight fat acid. In both processes a proportionate part of the glycerine is produced by the chemical action of the lime, and the remainder by the chemical action of the water.

Q. 24. As compared with the process of manufacturing fat acids commonly employed prior to Tilghman's invention, by using fourteen pounds of lime to one hundred pounds of fat and about thirty-
366 six pounds of sulphuric acid, does or does not the process patented by Mr. Tilghman show a reduction in the quantity of lime to be employed below zero, or a small comparative amount?

(Objected to by counsel for respondents as assuming that the process commonly employed prior to Mr. Tilghman's patent was that stated in the question, there being no proof on the subject.)

A. It does show such reduction.

Q. 25. Does or does not the said process of Tilghman show a reduction in the quantity of sulphuric acid to be employed, corresponding to the reduction in the amount of lime?

(Same objection as to last question.)

A. It shows a chemically proportionate reduction.

Q. 26. In the said process of Tilghman is or is not the reduction in the amounts of lime and sulphuric acid, respectively, due to the employment of the chemical power of highly-heated water?

(Objected to for form, being leading.)

A. It is entirely due to the chemical power of highly-heated water.

Q. 27. As compared with the old process of using fourteen pounds of lime and thirty-six of sulphuric acid to the one hundred pounds of fat, does or does not the process of the defendants show a reduction in the amount of lime used and the quantity of sulphuric acid employed?

(Objected to for the reason that there is no proof as to what was the "old process.")

A. It does show such reduction.

Q. 28. Is or is not this reduction of the quantity of lime and sulphuric acid in defendants' process due to the fact that the chemical power of water at a high temperature and pressure is employed?

(Objected to for form, being leading.)

A. It is entirely due to the chemical power of the highly-heated water which is employed.

Q. 28. Is or is not the action of the chemical power of highly-heated water in defendants' process and in Tilghman's identically the same?

(Objected to for same reason.)

A. It is identically the same.

Q. 30. Is or is not the employment of this chemical power of highly-heated water the characteristic feature of Tilghman's process as patented?

367 (Objected to for same reason.)

A. It is a characteristic feature of his process.

31. Q. Is or is not the presence of water in a liquid state essential both in the process of Tilghman and in that of the defendants?

A. It is essential.

Q. 32. Has the process of Tilghman or that of the defendants any resemblance to a process of distillation?

(Objected to for same reason.)

A. Neither of them has the slightest resemblance.

Q. 33. From your knowledge of chemistry, who would you say was

the discoverer of the chemical power of water in a liquid state at a high temperature and pressure on fats, to produce fat acids and glycerine?

(Objected to as calling for incompetent testimony.)

A. Mr. Richard A. Tilghman.

Q. 34. Do you know of any other person who has claimed the merit of this discovery?

(Objected to as calling for incompetent testimony.)

A. I know of no other.

Q. 35. Is this discovery regarded as a new and important fact in chemistry?

(Objected to as being leading and incompetent.)

A. It is so regarded.

Q. 36. Have you made any experiments on the action of water at high temperatures and pressures upon fats? If you state when and where, describe the experiments in detail and describe the results produced. If you deposited samples of the products of those experiments with any person, state when and with whom?

A. I made two experiments on the action of heated water on fats in my laboratory in August, 1860. In the first experiment lard was heated, with twice its weight of water, to 320 degrees Farenheit during 11 hours. All the water was drawn off and a small amount of fatty matter. The water contained glycerine, a sample of which was produced on the 4th of September, 1860, in the case Tilghman vs. Werk; was deposited with the commissioner, and marked No. 1, A., (C. F. H.) The quantity of glycerine proved that more than four-fifths of the lard had been resolved into fat acid and glycerine. A sample of the fatty product thus obtained was produced and deposited like the above sample, marked No. 1, A., (C. F. H.) Its highly acid character was
368 proved by its hardness as compared with the lard, by its crystallization, by its decomposing carbonated alkali with effervescence, by its great solubility in alcohol, and that this alcoholic solution reddened blue litmus. A sample of the lard used in this and the following-described experiments was presented and deposited as above, and marked 1, C., (C. F. H.) The fatty product was again treated with twice its weight of fresh water to 320° F. for 13 hours more, making 24 hours the whole time of its being heated to 320° F. At the conclusion of this last time the lard had been wholly resolved into fat acid and glycerine. The fat acid thus obtained was presented and deposited as above, marked 1, B., (C. F. H.) In the second experiment the lard was heated with twice its weight of water, but kept apart from each other, up to 612° F.; and when this temperature of 612° had been attained they were mixed by agitation and kept heated at 612° during five minutes. The lard was wholly resolved into fat acid and glycerine, samples of which were produced and deposited as above, marked No. 3 fat acids, No. 3 glycerine, (C. F. H.)

Q. 37. Have you made any experiments on the action of water and different proportions of lime, at high temperatures and pressures, upon fats? If yea, state when and where; describe in detail the experiments made, and the results produced. If you deposited samples of the products of those experiments with any person, state when, and with whom?

A. I made three experiments at the same time and place, as stated in my last answer. In the first experiment water was heated with half its weight of lard and one-half per cent. of lime, compared with the weight of the lard to 320° F. during twelve hours. The lard was resolved into fat acid, lime-soap, and glycerine. The fatty product treated by alcohol

gave a solution of fat acid, and left the lime-soap undissolved. Samples of the last were produced and deposited at the time and with the person named in the last answer, marked No. 2, (C. F. H.) The alcoholic solution, by evaporation, yielded fat acid. In the second experiment one hundred parts of lard were heated with one hundred and thirty parts of water and six and one-half parts of lime to 350° Fahrenheit during six hours. The fatty product thus obtained was produced and deposited as above, marked No. 4, (C. F. H.) Part of this product treated by alcohol gave a solution of free fat acid, leaving lime-soap undissolved.

Samples of these products were produced and deposited as above,
369 marked No. 4 lime-soap, No. 4 fat acid, (C. F. H.) In the third experiment one hundred parts of lard were heated with one hundred and thirty parts of water and twelve parts of lime to 350° F. for six hours. The lard was wholly resolved into lime-soap and glycerine. A sample of the product thus formed was produced and deposited as above, marked No. 6, (C. F. H.) Alcohol did not extract a trace of free fat acid from the product, proving the total conversion of the fat into lime-soap.

Q. 38. Can you state, from your own knowledge, whether or not free fat acids are formed under conditions substantially the same as those described in defendants' answer?

A. Free fat acids are necessarily formed where there is insufficient lime to neutralize all the fat, and when water, fat, and lime are heated in a close vessel to a pressure of about seventy-five pounds to a square inch.

Q. 39. State your opinion as to whether or not the free fat acids so formed are produced by the chemical action of water at a high temperature and pressure on fat, as set forth in the plaintiff's patent.

A. The free fat acids thus produced are exclusively produced by the action of highly-heated water, as set forth in the plaintiff's patent.

Q. 40. Was or was not the experiment you have referred to as made with twelve per cent. of lime made under substantially the same chemical conditions as that described in Roret's Encyclopedia, page 114, as Milly and Motard's patent? From your own experience, and from your scientific knowledge, can you speak positively as to whether or not any free fat acid is formed, or can possibly be formed, in the process described in Roret?

A. The experiment was made by me under the same conditions of time, temperature, and proportion of materials. I could obtain no fat acid from the product, and therefore affirm, on the grounds of chemistry and experience, that it is impossible to obtain free fat acid under such conditions.

Q. 41. Have you examined the samples of commercial stearic and oleic acid, furnished by defendants on the 17th of December, 1868, and state whether or not they contain any lime?

A. I examined them, and found that they contained lime.

Q. 42. In what state of chemical combination did this lime exist?

A. It existed as a lime-soap.

Q. 43. Does the fat acid of commerce, known as stearic acid, which has been prepared by the use of lime, generally contain a small proportion of lime, and state your authority?

370 A. It does contain lime. My authority is Dumas' Chemistry, vol. 6, page 680; Roret's Encyclopedia, page 163.

Q. 44. In what state of chemical combination does the lime exist in commercial stearic acid?

A. As lime-soap.

Q. 45. Do chemical substances, such as acids and alkalies, combine chemically with each other in all proportions, or only in certain definite proportions, and how are these proportions ascertained?

A. Acids and alkalies combine chemically only in definite proportions, which proportions are ascertained by the most exact experiments.

Q. 46. Is this received and recognized by chemists as a fundamental law of nature?

A. It is received by them as universally true

Q. 47. In what definite proportion does fat acid, particularly stearic acid, combine with lime?

A. Twenty-eight pounds lime combine with two hundred and seventy-five pounds anhydrous stearic acid in lime-soap, or one pound lime combines with nine and $\frac{82}{100}$ pounds anhydrous stearic acid.

Q. 48. As far as known to chemists, does stearic acid combine chemically with lime in any other proportion then the above? State the grounds of your opinion and what chemical treatises you have examined, and with what result.

A. Stearic acid is not known to chemists to combine in any other proportion with lime than that stated in my last answer. I have examined the following standard authorities: Watts' Chemical Dictionary, London, 1864; Gmelins' Chemistry, vol. 7, London; Berzelius' Chemistry, Brussels, 1838; Dumas' Chemistry, Paris, 1835; Gerhardt's Chemistry, Paris, 1854; Graham's Chemistry, London and Philadelphia, 1843. These chemistries all mention one, and only one combination of stearic or oleic acid with lime.

As chemistry is a positive science, based upon facts ascertained by experiments, no substance is regarded by chemists as a distinct chemical combination until after it has been produced in a pure and separate state, so that its distinctive properties can be ascertained by experiment, and its constitution determined by analysis. The combination above referred to as stearate and oleate of lime have been thus produced and analyzed, and their properties and constitution are recorded in chemical treatises. No other combination of stearic or oleic acid
371 and lime has been obtained in a separate and pure state, and consequently no other one is recognized by chemists.

Q. 49. From your chemical examination and analysis of defendant's product of December 17, 1868, state your opinion, as a chemist, what that product is, and give your reasons.

A. From my examination and analysis I am of opinion that the defendants' product is a mixture of free fatty acid and neutral lime-soap. My reasons are, that, by mixing defendants' product with numerous substances known in chemistry as neutral solvents, such as alcohol, ether, benzine, bisulphuret of carbon, coal oil, wood spirit, it separates spontaneously into a heavy white powder, which settles to the bottom, and a lighter liquid solution. I find that the white powder has all the properties of neutral lime-soap, and that by analysis it consists of fat acid and lime, in the same proportions as neutral lime-soap. I find that the liquids used as solvents, which originally were neutral, now contain an acid, and that by evaporation they leave a fatty body, which has all the properties of a fat acid; that it is acid to test paper, and remains acid after considerable quantities of caustic potash have been added to it. It drives out carbonic acid from carbonate of soda, and forms a soda-soap.

Q. 50. Did you find any lime in the fatty acids taken up by the solvents from defendants' product, and how much? In what condition does it exist, and how do you account for its presence?

A. Defendants' product was first mixed with cold alcohol, containing about 70 per cent. real alcohol, and filtered. The clear filtered solution was evaporated, and left a liquid fat acid. One hundred grains of this was burned, and left an ash weighing 0.49 grains of carbonate of lime, with a trace of iron. This is equal to 0.27 grains of lime. The residue on the filter was then mixed with cold alcohol of 93 per cent. real alcohol, and filtered. The clear filtrate was evaporated, and gave a hard fat acid. One hundred grains of this was burned, and gave an ash weighing 0.23 grains of carbonate of lime, which is equal to 0.13 grains of lime. In both cases the lime was in combination with its equivalent quantity of fat acid, forming a lime-soap, and this lime-soap has been dissolved by the mixture of free fat acid and alcohol.

Q. 51. Have you ascertained by actual trial that a mixture of free fat acid and alcohol will dissolve lime-soap to a certain extent, and whether it will dissolve more when hot than when cold?

A. It will dissolve lime-soap to a limited extent when cold, but
372 to a larger extent when hot; the hot solution, however, depositing nearly all the lime-soap on cooling.

Q. 52. Have you ascertained by actual trial whether alcohol of ordinary strength, say of 93 per cent. real alcohol, will dissolve lime-soap to a certain extent, and whether it will dissolve more when hot than when cold?

A. Alcohol of 93 per cent. will dissolve some lime-soap when cold, but it will dissolve more when hot than when cold.

Q. 53. Have you subjected defendants' product of December 17, 1868, to any mechanical treatment; and if so, with what result?

A. A quantity of defendants' product of December 17 was put between porous papers, and gradually squeezed or pressed, at first cold and afterwards hot, until it ceased to grease the papers. The substance left between the papers was a hard, dry, white powder, not greasy to the fingers, which was analyzed, and contained lime 8.9 per cent., and fat acid 9.03 per cent., and was a neutral lime-soap. The greased papers were treated with hot alcohol, which was then filtered and evaporated, and left a fluid oil, having all the properties of free fat acid. One hundred grains of it were burned, and left an ash weighing 0.49 grains of carbonate of lime, which is equal to 0.27 grain of lime. This lime was in the state of lime-soap, and was dissolved by the liquid fat acid which was absorbed by the paper.

Q. 54. Does this separation of defendants' product into two different substances, by purely mechanical means, prove anything as to its nature?

A. It proves beyond a doubt that the defendants' product is a mechanical mixture of neutral lime and soap and free fat acid.

Q. 55. Does the result of the mechanical treatment of the defendants' product prove any thing as to the correctness or incorrectne s of defendants' statement in their answer that their product does not contain any free fat acid, but is what they call an acid lime-soap, and give your reasons?

A. It proves conclusively that this statement is entirely incorrect. If defendants' product had been a chemical combination of the fat acid and lime-soap, or an "acid lime-soap," no mechanical force could possibly have separated the chemically combined substances. The fact that mechanical pressure did separate them proves conclusively that they were only mechanically mixed, and not chemically combined.

Q. 56. Please state in a connected form the different proofs that
373 defendants' product is not an "acid lime-soap," or chemical com-

bination of fat acid and neutral lime-soap, and that it is a mechanical mixture of these substances.

A. The proofs are—first, the fundamental law of chemical combination in definite proportions—to assume defendants' product to be a chemical combination would be a contradiction of this law; second, the authority of all chemical treatises that only one lime-soap is known to exist, namely, neutral lime-soap; third, the spontaneous separation of defendants' product into neutral lime-soap and free fat acid by mixture with many neutral solvents; fourth, the separation of defendants' product into neutral lime-soap and free fat acids, by simple mechanical pressure, without any kind of chemical treatment whatever; fifth, all these proofs mutually strengthen and corroborate each other.

Q. 57. So far as the economy or profit of defendants' process is concerned, and their saving of lime and sulphuric acid as compared with the old process of using fourteen per cent. of lime and twenty-eight per cent. of acid, does it make any difference whether their product with four or seven per cent. of lime is theoretically considered as being an acid lime-soap, or a mixture of neutral lime-soap and free fat acid?

A. It makes no difference whatever. Defendants' incorrect theory does not alter the fact.

Q. 58. Under either theory is it the use of the water at a high temperature and pressure which produces the chemical effect formerly produced by the extra quantity of lime and acid then used?

(Question objected to for form, and as assuming without proof the use of an extra quantity of lime.)

A. It is the water at a high temperature and pressure which alone produces the effect.

Q. 59. Describe the chemical action which takes place in defendants' digester, when charged with water, fat, and four to seven per cent. of lime, which are gradually heated and mixed by steam, noting particularly the successive stages or steps of the operation.

A. As soon as the heat rises nearly to 212° F., the lime begins to decompose the fat, and to form neutral lime-soap and glycerine. This action goes on until all the lime present has combined with its equivalent quantity of fat. The mass then consists of a mixture of neutral lime-soap and neutral fat and some glycerine dissolved in water. If the operation were stopped at this point, the product would be found
374 to contain no free fat acid whatever. This is the first stage of the process. Next, when the heat and pressure in the digester have risen sufficiently high above 212° F., the chemical action of the water begins gradually to decompose the neutral fat and to convert it into fat acid and glycerine. This action goes on with a rapidity proportionate to the heat and pressure employed, until finally all the neutral fat is decomposed, and the mass consists of a mixture of neutral lime-soap and free fat acid and of glycerine dissolved in the water.

Q. 60. Can you speak from personal knowledge and chemical examination of defendants' product as to the existence of these successive steps or stages in defendants' process?

A. I can speak from personal knowledge. On the 5th of October, 1868, I received from Cincinnati, by Adams' Express Company, a box addressed to R. A. Tilghman, containing alleged samples of defendants' products. I examined chemically the so-called "acid lime-soap" product, and found it to consist of a mixture of neutral lime-soap and neutral fat, and that it contained no free fat acid whatever. When treated with hot alcohol it was not even acid to test paper. It was evident that the materials had been heated in the digester only long enough to cause

the lime to combine with its equivalent quantity of fat acid and form neutral lime-soap; and that only this first stage of the process had taken place, and that the second stage, or the chemical action of the highly-heated water on the fat, had not yet begun. On the 18th of November, 1868, I received from Cincinnati another alleged sample of defendant's product, which I examined, and found it to consist of a mixture of some neutral lime-soap, some free fat acid, and some neutral fat. I concluded that in this case the operation had proceeded through the first stage and to some extent into the second stage, which, however, had not been entirely finished; that is, the lime had formed its equivalent quantity of lime-soap, and the highly-heated water had decomposed a part of the neutral fat into fat acids, but that sufficient time had not been allowed to decompose the whole of it. On the 17th of December, 1868, I received from the same source a third sample, in which I found only lime soap and fat acids, and no appreciable quantity of neutral fat. I concluded that in this case the second stage of the process had been entirely completed.

Q. 61. Are these two stages of defendants' process necessarily distinct and separate in point of time? and, if so, explain why.

275 A. They are necessarily distinct in point of time. Milk of lime will commence to act on fat below 212° F., and will act rapidly at 212° F., consequently, as defendants' digester is gradually heated, this action is the first that takes place, and until it is completed and the whole of the lime present has combined with fat acid so as to form neutral lime-soap, it is impossible that the second stage can commence, or that any free fat acid can be formed, because free fat acid and free lime cannot possibly co-exist in contact with *with* each other. After the first stage is completed, and no free lime is left, the second stage will commence as soon as the water has become heated sufficiently to act upon the neutral fat.

Q. 62. How would you designate or identify the two stages of defendants' process?

A. The first stage or formation of neutral lime-soap is the old lime saponification process of Chevreul & De Milly. The second stage or the formation of free fat acid by the action of highly-heated water, is Tilghman's process.

Q. 63. How you read, and do you understand, the papers marked defendants' Exhibits Nos. 1, 2, 3, and 19, being notices of the change of fat in Perkins' engine, and a description of said engine as contained in the agreed printed copy now shown you? State whether said exhibits contain any evidences of a prior knowledge or use of the process patented to complainant.

(Last portion of the question objected to for form, being leading.)

A. I have read and I understand them, and I do not find that they contain any evidence of a prior knowledge or use of complainant's process, because they make no mention of the decompossition of fats into fat acids and glycerine by the action of highly-heated water.

Q. 64. Explain in detail what fact is announced in Exhibit No. 1, entitled "Change of fat in Perkins' engine by water, heat, and pressure."

A. That paper states that a mixture of olive-oil and tallow which was used to lubricate the piston of a steam engine, and was thus exposed to the action of steam at a high temperature and pressure was carried on by the steam and produced in the condensed water a scum, differing in properties from the original fat. This scum was examined chemically and its properties are described. The writer states that it dissolves readily in alkalies, "more readily I think than fats, and,

376 in this respect, resembles Chevereul's acid of fat as well as in its solubility in alcohol." It is also stated that the substance is not soluble in ether, or very slightly so; that it does not melt in boiling water, and that when burnt it leaves an ash consisting principally of carbonate of lime. Each one of these last three named properties proves conclusively that the substance was not a fat acid of oil or tallow; for, on the contrary, a fat acid of oil and tallow is very soluble in ether, melts far below the heat of boiling water and, when burnt, leaves no ash. The properties in which the scum is stated to have resembled Chevreusl' acid of fat, namely, solubility in alkali and solubility in hot alcohol are indecisive resemblances, inasmuch as they belong also to neutral fats, and to soaps to a certain extent, the difference being one of degree only. The properties described, which are distinct, positive, and decisive, and not mere resemblances, namely, insolubility in ether, melting point above 212 F., and leaving an ash of carbonate of lime, are entirely different from the properties of fat acid. This proves conclusively that the scum was not fat acid.

Q. 65. Have you examined the properties of the fat acids of a mixture of oil and tallow, and can you state, from personal knowledge, how they compare with those of the scum as described?

A. I prepared the fat acid of a mixture of equal parts of olive oil and tallow, and treated it step by step in precisely the same manner as is described for the scum, namely, I dissolved it in hot alcohol, let it cool, and seperated the precipitate which formed by cooling and melting it. I found its melting-point to be 140° F.; that it dissolved freely and perfectly in ether, and that when burnt it gave no ash. In all these properties it differed absolutely from the scum as described, which cannot consequently have been the same substance. If the scum had been the fat acid of a mixture of oil and tallow it would have melted far below 212 F.; it would have dissolved freely in ether; and, when burnt, would have left no ash. It is described as having exactly the opposite properties, and cannot therefore have been the fat acids of a mixture of oil and tallow.

Examination adjourned to to-morrow (Tuesday) morning at 10 o'clock.

378 TUESDAY, *Feb. 16th*, 10 *a. m.*

Present: B. C. Tilghman, esq., for complainant; Charles B. Collier, esq., for defendants.

Examination of James C. Booth resumed.

Q. 66. Is the change produced in the fat, whatever that change was, described as having been produced by the action of water in a liquid state heated under pressure, or by the action of steam or water in the state of vapor at a high temperature and pressure?

A. In the detailed description contained in the paper, the action on the fat is three times distinctly stated to have been produced by the steam, and not once by water in a liquid state.

Q. 67. Would a chemist or manufacturer, possessed of ordinary skill and information on the subject, as current prior to 1854, if he should read defendants' Exhibits 1, 2, 3, and 19, have thereby become acquainted with the chemical fact that fat can be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

A. He would not, because the fact is not once mentioned.

Q. 68. As a matter of chemical history, did or did not chemists become acquainted with that chemical fact from the publication of those exhibits in 1823? And explain how you form your opinion. Give a list of the chemical treatises you have examined on the subject.

A. Chemists did not become acquainted with that fact from the publication of those exhibits in 1823. When new chemical facts or discoveries are published, they are collected and embodied in standard chemical treatises which represent the state of the science at the date of their publication. To ascertain whether a particular chemical fact was or was not known at a given date, say 1854, I should examine a number of the most authoritative treatises published at or before that date, and if none of these contained any mention of that fact when treating on the subject to which it related, I should then be compelled to conclude that the fact was not then generally or publicly known to chemists.

If, on examining new editions or treatises of a later date I found that several of them did mention the fact in question, I should then conclude that it had been discovered and first made public in the interval between the dates of the respective treatises.

I annex a list of standard chemical treatises of the highest authority, of dates between 1823 and 1854, which I have examined.
379 They all contain descriptions of the properties of fat and fat acids, and the known methods of producing fat acids and glycerine. None of them mention the fact that fat acids and glycerine can be produced by the action of water on the fats at a high temperature and pressure.

I annex another list of standard chemical treatises of dates subsequent to April 3d, 1854, all of which contain mention of that fact.

I therefore infer and conclude that that fact was first made known subsequent to 1852, and prior to April 3, 1854.

List of treatises published between 1823 and 1854, which do not mention that chemical fact:

Dumas' Chemistry. Vol. V. Paris, 1835. Pages 241, 262, 268–9.
Berzelius' Chemistry. Vol. II. Brussels, 1838. Page 487.
Ure's Dictionary of Chemistry. London, 1831. Page 461.
Brande's Chemistry. London, 1841. Page 1137.
Graham's Chemistry. London and Philad'a, 1843. Page 650.
Booth's Encyclopedia of Chemistry, Philadelphia, 1850. Pages 814 and 888.
Regnault's Chemistry. Paris and Philad'a, 1852. Page 687.
Gerhardt's Chemistry. Paris, 1854. Vol. II. Page 874.
Gmelin's Chemistry. Vol. VII. London, 1852. Page 230.
Pelouze & Fremy's Chemistry. Paris, 1850. Vol. III. Page 570.

List of chemical treatises published after April 3d, 1854, which do mention that chemical fact:

Comptes Rendus. Paris, April 3, 1854. Vol. XXXVIII. Page 671.
Liebig & Copp's Year Book. Giessen, 1855. Page 527.
Miller's Chemistry. London, 1862. Part III. Page 273.
Watt's Dictionary of Chemistry. London, 1854. Vol. II. Page 886.
Gmelin's Chemistry. Vol. XVI. London, 1864. Page 369.
Muspratt's Dictionary of Chemistry. Vol. II. London, about 1856–8. Page 252.
Chemical Gazette. London, 1856. Page 28.

Q. 69. State what technical works on the subject of the manufacture of fat acids, published between 1823 and 1854, you have examined, and whether any of them contain any description or notice of the process of manufacturing fat acids and glycerine from fat by the action of water at a high temperature and pressure.

380 A. I have examined the following technical works, all of which contain descriptions of the various processes for the manufacture

of fat acids. None of them mentions or refers to the process for the manufacture of fat acids and glycerine by the action of water on fats at a high temperature and pressure:

Chevreul & Guy Lussac's Patent. Paris, 1825.

Hebert's Encyclopedia. London, 1838. Page 306.

Dumas' Chemistry. Vol. VI. Paris, 1853. Page 674.

Parnell's Applied Chemistry. Vol. II. London, 1844. Page 303.

Knapp's Technology. London and Philadelphia, 1848. Vol. I. Page 222.

Roret's Encyclopedia. Fat acids. Paris, 1849.

Morfit's Chemistry of Soap and Candles. First Edition. Philadelphia, 1847. Page 431.

Payen's Chemistry. Paris, 1851. Page 756.

Official report of London Exhibition. London, 1851. Page 618.

Tomlinson's Cyclopedia of Arts. London, 1852. Vol. I. Page 291.

Appleton's Dictionary. New York, 1852. Vol. I. Page 213.

Ure's Dictionary of Arts. Boston, 1853. Vol. I. Page 354.

Q. 70. State what technical works on the subject, published since 1854, you have examined, and whether they mention the process of manufacturing fat acids and glycerine by the action of water on fat at a high temperature and pressure, and to whom they refer as the inventor of that process.

A. I have examined the following technical works. They all mention the process with highly heated water, and refer to Tilghman as its inventor:

Bulletin de la Societé d'Encouragement. Paris, 1855.

Official Report of London Exhibition. London, 1863. Class 4. Section A. Page 3.

Morfit's Chemistry of Soap and Candles. Second Edition. London and Philadelphia, 1856. Page 498.

Richardson & Watt's Technology. Vol. I. Part 3. London, 1863. Page 751.

Repertory Patent Inventions. Third series. Vol. XXIV. Page 408. London, 1854.

Mechanics' Magazine. Vol. LXI. Page 111. London, 1854.

Newton's Journal Arts and Sciences. Vol. XLV. London, 1854. Page 343.

381 Franklin Institute Journal. Third series. Vol. XXIX. Page 36. Philadelphia, 1855.

Q. 71. Please state in general terms the result of your examination of the standard chemical and technical publications.

A. None of the technical treatises or chemical works published prior to 1854 contains any mention either of the chemical fact of the decomposition of fat by water at a high temperature and pressure, or of the manufacturing process founded upon it. After 1854, both the chemical fact and the manufacturing process are mentioned in numerous technical and chemical publications.

Q. 72. Explain wherein the operation described in defendants' Exhibits 1, 2, 3, and 19, resembles, and wherein it differs from the process described and claimed in complainant's patent.

A. The operation described in those exhibits resembles complainant's process in that its title refers to a change of fat by water, heat, and pressure. It differs from complainant's process in that the change produced in the fat is not a change into free fat acid, but into another substance having properties altogether different from those of free fat acid. It differs also in the presence of lime, in unknown quantity, and from an

unknown source. It differs also in that the action is three times mentioned particularly as being caused by the steam, and only once by the water, and that in the title merely. It differs in producing a black, waxy scum, instead of a white, greasy substance; it differs in that its product is insoluble in ether instead of soluble in ether; that it does not melt at 212° F., instead of melting at about 110° F.; and that, when burned, it leaves an ash of carbonate of lime instead of leaving no ash. It differs from complainant's process in not mentioning distinctly the production either of fat acid or of glycerine.

Q. 73. What additional facts besides those mentioned in Exhibits 1, 2, 3, and 19, were required to be discovered in order to arrive at the invention of the process described and claimed in complainant's patent?

A. Starting from the information contained in those exhibits the following facts, partly additional and partly contradictory thereto, were required to be discovered: First. That the change of the fat was due to the action of liquid water, and not to the action of steam, as stated in the exhibits. Second. That the change would take place in the absence of lime, which was present in the operation described. Third. That, in the absence of lime, and by the action of liquid water,
382 and not of steam, a change of the fat would be produced entirely different from the change described in the exhibits. Fourth. That the changed fat would be a soft, white, greasy substance, instead of a hard, black, waxy scum; that it would melt at about 110° F., instead of not melting at 212° F.; that when burned it would leave no ash, instead of leaving an ash of carbonate of lime; that it would be soluble in ether instead of being insoluble. Fifth. That glycerine should be produced and recognized and described by name. Sixth. That free fat acid should be produced and recognized and described by name. Seventh. That the chemical action of water, if thus discovered, could be practically applied to the manufacture of free fat acid and glycerine.

Q. 74. State what is the reputation and authority of Dingler's Polytechnic Journal, as a standard work on chemistry and its allied sciences and arts.

A. It possesses a good reputation, and is referred to as an authority.

Q. 75. Does the reference in Dingler to the paper cited in Exhibit 1, show what amount of practical and scientific information was received by the public in Exhibit 1?

A. If any distinct discovery or new chemical action had been announced in Exhibit 1, it would undoubtedly have been plainly mentioned in that article in Dingler. We find, on the contrary, nothing but a suggestion that, "duly considered, it may possibly yet lead to many useful results."

Q. 76. Examine Morfit's Chemistry of Soap and Candles, Philadelphia, 1847, p. 163, now produced. Does it contain any statement of the chemical fact that fats can be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure? Explain what is there stated.

(Question 76 objected to by respondent's counsel, for the reason that the production of the book, or a transcript therefrom, is the proper and best evidence of its contents.)

A. It contains no mention of the fact that fats can be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure, nor the slightest reference or allusion to that fact. It refers expressly and exclusively to the combination of fat with the "alkalies" so as to make soaps, and explains that the presence of water is necessary for this "saponification."

The whole chapter treats wholly of the theory of soap-making. Water at a high temperature and pressure is not mentioned or referred to in the whole chapter.

383 Q. 77. Examine Exhibit 4, and state whether it contains any evidence of a prior knowledge or use of complainant's process, and explain wherein it resembles or differs from complainant's process.

A. It does not contain any evidence of a prior knowledge or use of complainant's process, since it does not mention the decomposition of fats into fat acids and glycerine by the action of highly-heated water. It resembles complainant's process only in treating fats in a close vessel at a high temperature and pressure. It differs from complainant's process in the use of a quantity of lime, sufficient to combine with and saturate all the fat acid and form a neutral lime-soap. It differs in employing the chemical action of lime to form lime-soap, instead of the chemical action of water to form free fat acids.

Q. 78 Examine defendants' Exhibit 5, and state whether it contains any evidence of a prior knowledge or use of complainant's process, and explain wherein it resembles or differs from complainant's process.

A. It contains no evidence of prior knowledge or use of complainant's process, for it does not even allude to the decomposition of fats into fat acids and glycerine by the action of highly-heated water. The former part of Exhibit 5 refers exclusively to the old lime-saponification process in open tubes, and suggests that thorough mechanical stirring would hasten the saponification, and might probably reduce the quantity of lime to more nearly the theoretical proportion required to make the neutral lime-soap. The last part of Exhibit 5 refers to the patents of Guy Lussac & Chevreul and Milly & Motard, for making lime-soap in a close vessel under pressure.

It resembles plaintiff's process only in the use of a close vessel. It differs from plaintiff's process in employing the chemical action of lime to produce neutral lime-soap, instead of employing the chemical action of water at a high temperature and pressure to produce free fat acids.

Q. 79. Refer to Roret's Encyclopedia, p. 113, now produced, and give a translation of the sentence which immediately precedes the last portion of defendant's Exhibit 5, commencing, "Another useful observation is presented," etc.

A. The translation of the sentence referred to is, "The quantity of lime necessary to saponify one hundred kilograms of fat may be fixed without hesitation at 14 kilograms."

Q. 80. Refer to Roret's Encyclopedia, p. 114, and quote the

384 original French of the clause near the bottom of page 5, defendants' Exhibit, beginning, "It is quite possible, etc.," and give a literal translation thereof.

A. The original French is, "Il n'est pas impossible qu'en reprenant aujourd hui cette idée, on ne parvienne a operer une diminution sensible dans la proportion de chaux caustique employée a la saturation d'un poids donné de matière grasse."

The literal translation is, "It is not impossible that by now again taking up this idea, we might succeed in effecting a sensible diminution in the proportion of caustic lime employed for the saturation of a given weight of fat."

Q. 81. Does the diminution of lime here suggested as possible, mean a diminution below the 9 and $\frac{35}{100}$ kilo's before stated, to be theoretically necessary to saponify 100 kilo's of fat; or does it mean a diminution of some of the loss or waste of 4 and $\frac{65}{100}$ kilo's lime used in practice over and above the theoretical 9 and $\frac{35}{100}$ kilo's?

A. The diminution of lime suggested as possible refers only to a diminution of the excess or waste in practice of 4 and $\frac{65}{100}$ beyond the 9 and $\frac{35}{100}$ theoretically necessary to saturate the fat, for all through the exhibit the saturation of the fat by lime is expressly referred to as indispensable.

Q. 82. Explain wherein the process described in the last part of Exhibit 5 resembles, and wherein it differs from the processes used by the defendants as described in their original and supplemental answers.

A. So far as the lime-soap portion of defendants' product is concerned, their processes resemble that described in the latter part of Exhibit 5. So far as the free fat-acid portion of defendants' product is concerned their processes differ from that in Exhibit 5, in employing the chemical action of highly-heated water to decompose neutral fat into free fat acid.

Q. 83. Examine defendants' Exhibit 6, and state whether it contains any evidence of a prior knowledge or use of complainant's process, and explain wherein it resembles or differs from it.

A. Exhibit 6 does not contain any evidence of prior knowledge or use of complainant's process, as it does not allude to the decomposition of fats into fat acids and glycerine by the action of highly-heated water. It describes the saponification of fats by alkalies so as to make soaps, either in open vessels or in close vessels under pressure. These soaps are afterwards decomposed by acids, to set free the fat acids. It
385 does not employ the chemical action of highly-heated water on fats to make fat acids, and therein differs from complainant's process.

Q. 84. Examine defendants' Exhibit 7, and state whether it contains any evidence of a prior knowledge or use of complainant's process.

A. It does not. It refers to a method of rendering tallow by steam, or in a Papin's digester, which is stated to make it uncommonly hard. It does not mention or refer to the production of fat acids.

Q. 85. Examine defendants' Exhibit 8, and state whether it contains any evidence of a prior knowledge or use of complainant's process.

A. It contains no such evidence, since it makes no mention of the decomposition of fats into fat acid and glycerine by the action of highly-heated water.

Q. 86. Refer to the original work, Payen's Chimie Industrielle, Paris, 1851, now produced, and give a translation of the entire passage on page 766, from which the latter part of Exhibit 8 is a partial extract.

A. The title is "New Manufacture of Fat Acids by Distillation," 1, Historical. The remarkable labors of several savans and manufacturers have given birth to this great new manufacture. After the discoveries of Mr. Chevreul, as to the constitution of fats, Mr. Bussy and Lecanu proved, in 1840, that these substances could be decomposed under the influence of heat into several products, and be transformed especially into fat acids, which pass over by distillation. Messrs. Thomas and Laurent applied superheated steam to several manufacturing operations. In 1841, M. Du Brunfaut conceived the idea of obtaining the fat acids on a manufacturing scale by decomposing the fats by a current of steam of high temperature. Some years since M. Fremy published the results of accurate researches upon sulphuric saponification. Finally, Mas et Tribouillet, putting to use all these observations founded, by the aid of new processes and ingenious apparatus, the remarkable manufacture which we are about to describe.

Q. 87. Have you read, and do you understand, Du Brunfaut's patent of 1841, for the process above referred to?

(Question objected to by counsel for defendants, inasmuch as Du

Brunfaut's patent is not among the references made by the respondents, and for the further reason that the question assumes, without proof, that DuBrunfaut's patented process is that referred to in respondents' Exhibit No. 8.)

386 A. I have read, and I understand, the French patent to M. Du Brunfaut, No. 12066, granted 25th of August, 1841.

Q. 88. State wherein the description in Du Brunfaut's patent resembles, and wherein it differs, from complainant's patented process.

(Question objected to by counsel for respondents, inasmuch as Du Brunfaut's patent is not referred to by the defendants in their answer, and is not in evidence.)

A. It resembles it in producing a fat acid at a high heat. It differs from it in being a distillation of fat acid, in employing the heated vapor of water and producing no glycerine.

Q. 89. Have you ever tried the experiment of obtaining fat acid according to Du Brunfaut's process, by decomposing the fats by a current of steam of high temperature; if so, what were the results produced?

(Question objected to for the same reason as stated in the objection to the preceding question.)

A. I distilled a half pound of lard for a half hour, driving an abundance of superheated steam through it. The odor of acroleine filled the whole room, causing pain to the eyes and flow of tears. I obtained thereby eleven per cent. of the whole fat distilled over, which was entirely soluble in heated alcohol, which solution, when cooled, gave a small precipitate of unaltered fat, proving it to be fat acid.

Q. 90. How long would it take to decompose a charge of neutral fat by Du Brunfaut's process, as compared with the time required at the same heat with liquid water, as described by Tilghman?

(Objected to for same reason as to preceding question.)

A. I obtained, by Du Brunfaut's method, eleven per cent. of fat acid in half an hour, at which rate it would have required four and a half hours to distil the whole. In an experiment with Tilghman's process, at about the same temperature, determined by melting lead, the whole fat was changed into fat acid and glycerine in five minutes, and in the coil apparatus nearly two gallons of fat were changed into fat acid and glycerine in less than an hour at the temperature of melting lead.

Q. 91. From your knowledge of the properties of glycerine, can you state whether the "blackish syrupy or viscid residue," which remains in Du Brunfaut's still, is "nothing but glycerine," or "an altered product of this substance," as stated by Du Brunfaut?

(Objected to for same reason.)

387 A. It is impossible that it should be glycerine, because glycerine distils over at a comparatively low temperature. Wilson's patent states the medium point of the distillation of glycerine to be 370° F., as ascertained in his process for refining glycerine, and Berthelot states that he cannot evaporate an aqueous solution of glycerine in a water bath without losing one-sixth of the weight of glycerine, the heat in this case being 212° F., or below. Du Brunfaut states that when he obtained this black, viscid residue, the temperature was 626° Fahrenheit.

Q. 92. State whether the description of Du Brunfaut's process, in Exhibit 8, contains any evidence of a prior knowledge of use of complainant's process, and explain wherein it resembles or differs from complainant's process.

A. It contains no such evidence, since it makes no mention of the

manufacture of fat acid by the action of highly-heated water. Du Brunfaut decomposes fats by a current of steam at a high temperature; plaintiff decomposes fats by a highly-heated water. Du Brunfaut decomposes fats at ordinary pressure; the plaintiff decomposes fats at a high pressure. Du Brunfaut employs an open vessel; plaintiff employs a closed vessel. Du Brunfaut employs steam or the vapor of water; plaintiff employs liquid water.

Q. 93. What is the reputation and authority of Payen's Chemie Industrielle among chemists and manufacturers?

A. It has a high reputation, and is considered an excellent authority.

Q. 94. State whether or not the above sketch of the history of the manufacture of fat acid in Payen is a proof that the process of decomposing fat into fat acid and glycerine by the action of water at a high temperature and pressure was not generally known to chemists and manufacturers in 1851.

(Question objected to for form, and for the further reason that the function of a witness is not to testify to that which is matter of pure argument.)

A. From his acknowledged thoroughness in the work quoted, it is a proof that this last process was unknown in 1851, or it would have been mentioned in a historical sketch of the successive inventions in the manufacture of fat acids.

Q. 95. State whether the manufacture of fat acids was originally invented by French chemists, and whether the subsequent improvements up to that date were principally made by them.

(Objected to as being leading, and as calling for the mere
389 opinion of the witness as to facts not connected with this case, and which facts can be proven, if competent, by the production of printed works relating to the subject-matter of the question.)

A. It was invented by Chevreul & Guy-Lussac, and the improvements, up to 1851, were chiefly made by French chemists.

Q. 96. Examine the first part of Defendants' Exhibit 8, and complete the unfinished sentence by translating from the original book, page 771.

A. The entire sentence is: "At this temperature, and under the influence of a current of steam, the transformation (into fat acids and glycerine) of the last portions of the neutral fat is finished, and the fat acids are carried off in vapor by the current, and pass with the steam by the tube L into the middle vessel M, and from this by the tube N into the double worm O O."

Q. 97. State whether the first part of Exhibit 8 contains any evidence of a prior knowledge or use of complainant's process.

Describe the process here referred to, and explain wherein it resembles or differs from complainant's process.

A. The exhibit contains no proof of prior knowledge or use of complainant's process. In the process described in the exhibit, the fat is mixed with from eight to sixteen per cent. of strong sulphuric acid, and heated to 230° F. for twelve to eighteen hours. The sulphuric acid decomposes the fat by taking away its glycerine and sets the fat acid free. The mixture is then washed with boiling water, which takes away the glycerine and sulphuric acid, leaving the fat acid of a very dark color. This fat acid is then heated in a still, and superheated steam passed through it, which carries off the fat acid in a state of vapor. This vapor is condensed, and the fat acid is obtained white and pure.

This process differs entirely from Tilghman's. In Payen's process the glycerine is separated from the fat by sulphuric acid; in Tilghman's by highly-heated water. In Payen's, the fat acids are distilled; in Tilgh-

man's they are not distilled. In Payen's, open vessels and no pressure are used; in Tilghman's, closed vessels and high pressure are essential. In Payen's, no liquid water is or could possibly be mixed with the highly-heated fat; in Tilghman's, mixture of liquid water with highly-heated fat is essential.

Q. 98. Have you read, and do you understand, defendants' Exhibit 9, and have you examined the original publication in the Philosophical Transactions?

A. I have read, and I understand it; and I examined the original paper in the Philosophical Transactions.

390 Q. 99. Does Exhibit 9 contain any evidence of a prior knowledge or use of complainant's process?

A. It does not.

Q. 100. Does it contain any announcement of the chemical fact that fat can be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

A. It does not.

Q. 101. Explain what fact is announced in that paper.

A. It is stated that a stratum of castor oil was placed on the surface of the water, in the cistern of a water barometer, and that after the lapse of nearly two years some drops of a liquid resembling glycerine were formed on the surface of a mucilaginous substance which had formed on the top of the oil.

Q. 102. Is it anywhere stated in that paper that the oil was ever exposed, in contact with the water, to a high temperature and pressure?

A. It is not.

Q. 103. Has that paper any real connection with, or relation to, the process claimed in Tilghman's patent, or the chemical fact on which it is based?

A. It has not the slightest.

Q. 104. State whether you have examined Daniell's Introduction to Chemical Philosophy, London, 1843, pages 616, 617; whether it is by the same author as Exhibit 9; whether it contains descriptions of the known methods of decomposing fat acids, making fat acids, and whether it contains any mention of the process of decomposing fats into fat acids and glycerine by the action of water, either at common temperature or at a high temperature and pressure.

(Objected to for the reason that the publication referred to in the question is not referred to in defendants' answer; and that the production of the book is the proper evidence of what it contains or does not contain, and that the question calls for negative testimony.)

A. I have examined J. Frederick Daniell's Introduction to the Study of Chemical Philosophy, London, 1843. It is by the same author as quoted in Exhibit 9. The only notices contained in that work of methods of decomposing fats are on pages 616 and 617. On page 616 it mentions that glycerine may be separated from oil or fat by boiling the latter with a solution of caustic alkali or oxyde of lead, whereby

391 soaps or plasters are formed and the glycerine separated. On pages 616 and 617 the stearic, margaric, and oleic acids are stated to be obtained by saponifying stearine, margarine, and oleine with caustic potash, and then decomposing the stearate, margarate, and oleate of potassa by muriatic acid. No other method of obtaining fat acids is mentioned. Daniell's work contains no mention of the process for decomposing fats by the action of water, either at common temperature or at a high temperature and pressure.

Q. 105. Examine defendants' Exhibit 10, and state whether you have

read and understand the English patent to Radley & Meyer, May 25th, 1850, No. 13081.

A. I have read it, and I understand it.

Q. 106. Does that patent contain any evidence of a prior knowledge or use of complainant's process?

A. It contains no such evidence, since it does not mention the decomposition of fats into fat acids or glycerine by the action of highly-heated water.

Q. 107. Examine page 13, section 3, of the printed copy now produced of Radley & Meyer's patent, and explain the process therein described, and state wherein it resembles or differs from complainant's process.

A. The process described is for treating bones or animal offal with from two and a half to fifteen per cent. of lime, or with soda or potash in a close digester at a temperature of 212° to 250° F. or upwards, and states that they are "thus saponified by the action of steam or other heat." The soaps thus produced are to be used for making candles or as common washing soap.

As bones contain but nine per cent. of fat, (Payen's Chemie Industrielle, Paris, 1851, page 695,) the proportion of lime stated would be from 27 to 166 per cent. of the weight of the fat in the bones, or from two to twelve times as much as is commonly used to saponify fats. This process produces lime-soap by the chemical action of lime on fats, and therein differs from the plaintiff's, which produces free fat acids by the chemical action of highly-heated water.

The bones are described to have been "previously detached from the chondrine, gelatine, and other animal matter deprived therefrom, by digestion for a few hours with water at the temperature of 212° to 350° F., according to the degree of purification required, the greatest degree of purity resulting from the highest temperature." The gelatine and bone earth thus obtained are to be mixed with washing soap.

392 This process has no connection whatever with plaintiff's process of decomposing fats by the action of highly-heated water.

Q. 108. Examine pages 14, 15, 16, 17 and 18 of Radley & Meyer's patent, chapter third, sections 1 to 5. Explain the process therein described, and state whether it contains any evidence of a prior knowledge or use of complainant's process, and explain wherein it resembles or differs therefrom.

A. The process described is to make lime-soap by putting into a close digester, tallow with fourteen per cent. lime, or oil with seven per cent. lime, which lime is slacked with about twice its weight of boiling water, then adding ten to twenty per cent. of clean sand, and agitating from two to five hours, during which time the heat is to be raised to from 220° to 250° F., and when the saponification is known to be completed from samples taken, the digester is cooled. The lime-soap thus produced is to be washed with water to extract the glycerine, then finally ground and sifted, and then boiled two or three times for half an hour to six hours with weak solutions of caustic soda, to completely remove the glycerine. The purified and finely-powdered lime-soap is then again boiled two or three times more, for two and a half to ten hours, with stronger solutions of caustic soda, which are stated to decompose the oleate of lime and make oleate of soda or common washing soap, which is separated by filtration from the stearate of lime. This stearate of lime is next decomposed by strong acids which set free the stearic acid, or it may again be boiled with still stronger solutions of soda to make common hard washing soap.

The whole of this process refers exclusively to the making of lime or soda soaps in a close digester under pressure. In fact, the product is designated as soap forty-five times in this description. Not a word is anywhere said about free fat acid being produced in the close vessel, nor about the fat being decomposed by the action of highly-heated water.

Examination adjourned to to-morrow (Wednesday) morning at 9.30 o'clock.

WEDNESDAY, *Feb. 17th*, 9½ *a. m.*

Present: B. C. Tilghman, esq., for complainant; Charles B. Collier, esq., for defendants.

Examination of James C. Booth resumed:

Q. 109. Have you performed the operation above described of
393 treating oil with seven per cent. lime in a close vessel? If so, describe your operation and its results; state when and where it was made, and in whose presence.

A. I made an operation in exact conformity to the directions in Radley & Meyer's patent on the 25th of March, 1868, at the complainant's laboratory in Philadelphia, in the presence of Dr. Robert E. Rogers, the complainant, and his brother, Gen. B. C. Tilghman, and a workman. About seven pounds lard oil, with seven per cent. lime slacked with twice its weight of water, were put into a close vessel or digester provided with a rotary paddle or agitator and a thermometer. We then added twenty per cent. clean sand, and kept the materials constantly agitated by the paddle, and raised the heat to 232° F., and kept it at that point during three and three-quarters hours; we then raised the heat to 250° F., and kept it at that point during one hour and twenty-three minutes, making five hours and eight minutes heat in all. The first samples drawn were alkaline, showing free lime; they became gradually less decidedly alkaline and at last neutral. After the lapse of five hours and eight minutes the materials were drawn out and were found to be a mixture of neutral lime-soap and neutral oil. No free fat acid was contained in it.

Q. 110. Is it anywhere stated or implied in Radley & Meyer's patent that by the process there described, of treating oil with seven per cent. of lime in a close digester, and free fat acid or "acid lime soap" is formed?

A. It is not anywhere so stated or implied; on the contrary, the only product mentioned in that process is called lime-soap, rock-soap, glycero-pinguate of lime.

Q. 111. Can you state, from your own knowledge, derived from experiment, whether by performing the operation there described, with oil and seven per cent. of lime, any free fat acid or any so-called acid lime-soap is produced, and state what is produced?

A. I can state from my own experiment that no free fat acid or so-called "acid lime-soap" is produced; the product is a mixture of neutral lime-soap and neutral oil.

Q. 112. What effect would the repeated boilings with solutions of caustic soda, as directed in the patent, have upon that product?

A. It would convert any neutral fat in it into soda-soap.

Q. 113. Suppose that by accident any free fat acid did exist in that product, what effect would these boilings with solutions of caustic soda have upon that fat acid?

394 (Question objected to as assuming that the existence of free fat acid in said product would be by accident.)

A. The soda would combine with it and form a soda-soap.

Q. 114. Taking all the stages of that process as described in the patent to have been carried out, is it in a chemical sense possible that the product should contain any free fat acid?

A. It is chemically impossible.

Q. 115. Explain wherein defendants' processes, as described in their original and supplementary answers, resemble, and wherein they differ from the Radley & Meyer's patent.

A. So far as the production of the neutral lime-soap portions of the defendants' product is concerned, their processes resemble Bradley & Meyer's process. So far as the production of the free fat-acid portion of their product is concerned, their processes are different from Radley & Meyer's process. Radley & Meyer use tallow with fourteen per cent. lime, or oil with seven per cent. lime. Defendants use tallow or solid fat with from four to seven per cent. lime, and do not use oil at all. Defendants use more water, more heat, more pressure, and more time than Radley & Meyer, and obtain a different product. Radley & Meyer stop the heat as soon as saponification is completed; defendants do not stop the heat as soon as saponification is completed, but, on the contrary, continue it so as to decompose the remaining and unsaponified neutral fat into fat acids by the action of highly-heated water. Radley & Meyer boil their product four to six times with caustic soda. Defendants do not boil their product with caustic soda. Radley & Meyer produce lime-soap or rock-soap, and no free fat acid. Defendants produce in part lime-soap and in part free fat acid. Radley & Meyer do not employ the chemical action of highly-heated water to decompose fat into free fat acid and glycerine. Defendants do employ the chemical action of highly-heated water to decompose fat into free fat acid and glycerine.

Q. 116. What chemical action or effect has the sand used in Radley & Meyer's process?

A. No effect—none whatever.

Q. 117. What chemical action or effect has the sand used in defendants' process?

A. None whatever.

Q. 118. State how long the specification of Radley & Meyer's patent is, and how many claims are made in it. Does this patent show much chemical or practical knowledge in its authors?

395 (Question objected to for incompetency.)

A. Radley & Meyer's patent covers thirty-eight printed quarto pages. It has twenty-six claims. It shows very little knowledge, either chemical or practical, in its authors.

Q. 119. Examine defendants' Exhibit 11, and state whether it contains any evidence of a prior knowledge or use of complainant's process.

A. It contains no such evidence.

Q. 120. Have you examined the original article in the Comptes Rendus, from which this exhibit is an extract? If so, state what are the volatile fatty acids referred to, and what are the combinations with glycerine referred to.

A. I have examined the original in the Comptes Rendus. The volatile fatty acids referred to are valeric, butyric, and acetic acids. The combinations with glycerine referred to are—

1. Valerines, monovalerine, divalerine.
2. Butyrines, monobutyrine, dibutyrine, butyridine.
3. Acetine.

Q. 121. Are these substances the same as what are commonly called,

in ordinary language, oils and fats? Are the acids referred to the same as what are called the oily and fatty acids, and are used in the candle and soap manufacture? What is the common name of acetic acid?

A. These substances are not the same as ordinary oils and fats, but are interesting chemical curiosities. The acids are not the same as those used in the soap and candle manufacture. The common name of acetic acid is vinegar.

Q. 122. In the whole course of your chemical experience did you ever see one pound of any of the substances referred to except acetic acid?

A. I have not.

Q. 123. Examine Exhibit 12, and state whether it contains any evidence of a prior knowledge or use of complainant's process.

A. None whatever, as it does not mention the decomposition of fats into fat acid and glycerine by the action of highly-heated water.

Q. 124. Explain wherein Scharling's process, as described in Exhibit 12, resembles or differs from complainant's process.

A. In Scharling's process oils or fats are heated in an open vessel or still, and superheated steam passed through them. The fat acids
396 are thus distilled over and condensed in a cold receiver. Scharling's process is essentially the same as Du Brunfaut's in defendants' Exhibit 8. It is merely carried on at a lower temperature and less rapidly, so that for tallow it is stated to be too slow for practical use. Scharling's process resembles complainant's only in one point, that they both produce fat acids. Scharling distils the fat acids; plaintiff does not distil them. Scharling's process requires open vessels; plaintiff's process requires close vessels. Scharling's process is performed without pressure; plaintiff's process requires pressure. In Scharling's process no liquid water is or can possibly be mixed with the heated fat; in plaintiff's process liquid water must necessarily be mixed with the heated fat. In plaintiff's process the glycerine is found dissolved in the water. In Scharling's process no mention is made of the glycerine.

Q. 125. Examine defendants' Exhibit 13, and state whether it contains any evidence of a prior knowledge or use of complainant's process.

A. It contains no such evidence, as it does not mention the decomposition of fatty bodies into fat acids and glycerine by the action of highly-heated water,

Q. 126. State whether you have compared defendants' Exhibit 13 with the official French publication there cited, and whether it is a perfectly correct translation. Give the original French of any part you think incorrectly translated, and add a correct translation thereof.

A. Defendants' Exhibit 13 is mainly a correct translation, except that in the fourth line the word injure should be alter, the French word being "alterer." The sentence should read, "The chief object of this invention is to effect the separation of these two substances by a simple process which tends neither to alter them nor to increase their price;" also in the seventh line, the phrase, "I take ordinary fat or branches," should be, "I take ordinary tallow or tallow in branches," the French word being "suif." Again, in the tenth line, the word "fat" should be tallow, the original being "suif."

Q. 127. Examine the paper now produced and marked by the commissioner, Complainant's Exhibit "Booth 1," and state whether you have compared it with pages 22 and 23, tome 23, Brevets D'Inventions, Paris, 1832, and whether it is a correct copy thereof.

A. I have examined it and compared it with the original, and found it a correct copy.

Q. 128. Explain wherein the process described in Exhibit 13 resembles or differs from complainant's process.

397 A. In Exhibit 13, tallow or raw suet is held in "ebullition" in a digester with water for a certain time, until the tallow, when cooled, presents a granular appearance. It is then pressed, to separate the liquid from the solid. It is not stated that any heat above 212° F., or any pressure was employed; both the material employed and the product are stated to be "tallow," and the process is expressly stated not to "alter" the fatty bodies. It is not stated that any fat acids or glycerine were produced. The process has no point of resemblance to plaintiff's process.

Q. 129. Examine defendants' Exhibit No. 14, and state whether it contains any evidence of a prior knowledge or use of complainant's process. Explain wherein it resembles or differs from complainant's process.

A. Exhibit 14 contains no evidence of a prior knowledge or use of plaintiff's process, as it does not mention the decomposition of tallow into fat acid and glycerine by the action of highly-heated water. Appert's process in Exhibit 14 is for melting raw suet with water in a close vessel, at a temperature of 239° to 266° F., or about ten to twenty-two pounds pressure, for one hour, and the resulting product is expressly stated to be tallow, and to be dry and sonorous and very white. It is not stated that any free fat acid or glycerine is produced.

Q. 130. Examine defendants' Exhibit 15, Manicler's patent, No. 5345, and state whether it contains any evidence of a prior knowledge or use of complainant's process. Explain wherein it resembles or differs from complainant's process. Quote from the printed patent the last three sentences of the specification.

A. Exhibit 15 contains no evidence of prior knowledge or use of plaintiff's process. The last three sentences of the specification are: "Instead of preparing fatty substances from tallow, by digesting it with water, as hereinbefore described, the same results may be obtained by melting tallow in an ordinary boiler and adding oil of turpentine thereto, in the proportion of one part by weight of oil of turpentine to about seven parts by weight of tallow; the subsequent treatment of the tallow after being so melted with oil of turpentine being the same as if it had been digested by water in the manner hereinbefore described. The oil of turpentine may be recovered from the liquid, oily matter which is squeezed out during the operation of pressing, by distilling the said liquid oily matter with a gentle heat. The oily and liquid matter which is separated from my new preparations of fatty substances may

398 be used to burn in lamps for common purposes, or for making of soap, and for oiling machinery, or for other purposes, for which animal oil is or may be used." Manicler's patent describes a process for heating tallow or raw fat with water in a close digester for six hours to about 250° F., or fifteen pounds pressure, then cooling the fat and pressing it between cloths, so as to separate the liquid oil from the solid fat. The solid parts are to be used for making candles, and the liquid fats "may be used to burn in lamps for common purposes, or for making soap and for oiling machinery." It states that "the same results may be obtained by melting tallow in an ordinary boiler and adding oil of turpentine thereto," as by "digesting it by water." All these statements prove that the thing produced in Manicler's process was neutral oil, and not fat acid. Fat acid cannot be used to burn in lamps, or for oiling machinery. Fat acid cannot be produced by mixing turpentine

with neutral fat. Manicler's process differs from plaintiff's in the essential point that it makes neutral fat, and plaintiff's makes fat acid.

Q. 131. Examine defendant's Exhibit 16, and state whether it contains any evidence of a prior knowledge or use of complainant's process.

A. It contains no such evidence.

Q. 132. State whether you have read and understand the English patent to James Collier and N. H. Manicler, No. 6121, now pro duced and marked by commissioner Complainant's Exhibit, Booth' 2. State whether the description of Collier and Manicler's process in defendant's Exhibit 16 is a literal extract from said patent. Explain the process described in Exhibit 16, and in that patent, and state wherein it resembles or differs from complainant's process.

(Question objected to for the reason that Collier and Manicler's patent is not referred to in defendants' answer, and the reference contained in Exhibit No. 16 does not purport to be a copy of, or extract from, said patent.

A. I have read and I understand that patent. The description in Exhibit 16 is a literal extract from said patent. They both state that the invention consists in obtaining from palm oil a perfectly fluid oil, "especially suitable for burning in lamps," and a hard fat, excellent for candles. The palm oil is put into a digester with one-sixth of water, and heated until the pressure is two or three atmospheres for about two hours. It is then cooled and pressed, to separate the liquid from the solid parts. It is not stated that any glycerine or fat acid is pro-
399 duced. From the statement that the oil produced was "especially suitable for burning in lamps," it is evident that it was neutral oil, and not oily acid, because oily acids are incapable of burning in lamps. The process differs from plaintiff's in the essential feature that it produces neutral fat, and not fat acid.

Q. 133. State whether the quotation in your answer of the words, "especially suitable for burning in lamps," is made from defendants' Exhibit 16, or from Collier and Manicler's patent, upon No. 6121.

A. It is from Collier and Manicler's patent alone.

Q. 134. Examine defendants' Exhibit No. 17, Walther's patent, No. 8572, and state whether it contains any evidence of a prior knowledge, or use of complainant's process. Explain the process described in Walther's patent, and state wherein it resembles or differs from complainant's process.

A. It contains no such evidence. The process is for passing currents of high pressure steam through oils and fats, contained in a close vessel provided with a safety-valve loaded to from two to five atmospheres, so that the oil is heated, and subjected to the steam during five or six hours. The effect described is, that the volatile bad-smelling impurities are carried away with the escaping steam, and the oils are more pure and will be more suitable for soap-making or for burning in lamps. The escaping steam is to be condensed, and an impure oil is found floating on the surface of the condensed water. When oils which have been previously treated by sulphuric acid are to be purified, one-tenth of water saturated with lime is put into the digester with the oil. Saturated lime-water contains one seven hundred and thirtieth of lime; consequently, the whole amount of lime present would be equal to $\frac{1}{73}\frac{1}{00}$ of the weight of the oil. When fat or tallow is to be purified, no lime water is used.

No mention is made that any fat acid, or glycerine, was produced by this process. The statement, both in the title of the patent and in the description, that the oil was made more suitable for burning in lamps, shows clearly that the oil remained neutral oil, and was not converted into oily acids, as oily acids are entirely unfit for burning in lamps.

The efficient agent in Walther's process is a current of high pressure steam passing through the heated fat. The efficient agent in plaintiff's process is liquid water mixed with the heated fat. The action taking place in Walther's process is the carrying off, or distilling with
400 the steam, of volatile bad-smelling oils. The action taking place in plaintiff's process is the decomposition of the fat into fat acid and glycerine, by the highly-heated water, and nothing is distilled from the fat. Walther does not decompose the neutral fat—does not make any fat acid or glycerine, and leaves the fat in a neutral state. Plaintiff's process decomposes the neutral fat, and makes fat acid and glycerine. The two processes resemble each other only in the fact that both treat fats in close vessels at a high temperature and pressure. They differ entirely in the method of operating, in the chemical principle involved, and in the results produced.

Q. 135. Does any one of defendants' Exhibits, Nos. 1 to 19, contain a description of a process substantially resembling complainant's process in principle and operation? Does any of said exhibits contain the announcement of the chemical fact upon which complainant's process is based?

A. Not one of the defendants' Exhibits, from 1 to 19, describes a process substantially resembling the plaintiff's in principle or operation. Not one of said exhibits announces the cardinal fact of plaintiff's process, that fats are decomposed into fat acids and glycerine, by the action of water at a high temperatue and pressure.

Q. 136. Please make in parallel columns a condensed statement of the essential points of difference between complainant's process, and the processes described in defendants' Exhibits Nos. 1 to 19.

A. The following is the condensed statement:

Processes in Def'ts' Exhibits.	Plaintiff's Process.
Perkin's Scum, (*Exh.* 1, 2, 3, 19,)	
Does not state that fat acid or glycerine was produced.	States that fat acids and glycerine are produced.
The thing produced was insoluble in either, did not melt at 212° F., and when burned left an ash of carbonate of lime.	The thing produced is soluble in ether; melts at 110° Fahr. When burned leaves no ash.
The thing produced was not fat acid.	The thing produced is fat acid.
Roret (*Exh's*, 4 *and* 5,(*Gay Lussac & Chevreul* (*Exh.* 6.) *Radley & Meyer* (*Exh*, 10.)	
Make neutral lime-soap either in open or closed vessels.	Produces no soap.
Do not make free fat acid.	Makes free fat acid.
Lime is the chemical agent which decomposes the fat.	Highly heated water is the chemical agent which decomposes the fat.
401 *Papin* (*Exh.* 7,) *Manicler*, (*Exh.* 13,) *Appert* (*Exh.* 14,) *Manicler* (*Exh.* 15,) *Collier & Manicler* (*Exh.* 16.)	
Tallow is rendered or melted in close vessels—remains neutral tallow—is not decomposed into fat acids and glycerine.	Tallow is decomposed into fat acid and glycerine.

Payen (*Exh.* 8,)	
Fat is decomposed by sulphuric acid, and the fat acid afterwards distilled.	Fat is decomposed by liquid water. Fat acid is not distilled.
Open vessels used—no pressure used.	Close vessels and high pressure necessary.
No liquid water mixed with the heated fat.	Liquid water mixed with the heated fat necessary.
No glycerine obtained.	Glycerine obtained, dissolved in the water.
Du Brunfaut's (*Exh.* 8,) *Scharling* (*Exh.* 12.)	
Fat is heated and fat acid produced by distillation with steam.	Fat acid is not distilled.
Open vessels used—no pressure used.	Close vessels and high pressure necessary.
No liquid water present.	Liquid water necessary.
Glycerine is not obtained.	Glycerine obtained, dissolved in water.
Daniell (*Exh.* 9.)	
Castor oil kept two years in open air became rancid. No close vessel; no high temperature or pressure.	Fat decomposed by water, in close vessels at high temperature and pressure.
No production of fat acid described.	Produces fat acid and glycerine.
Comptes Rendus, (*Exh. H.*)	
Substances used are not commercial oils or fats.	Commercial fats are used.
Volatile fat acids produced are not the commercial fat acids fit for candles or soap.	Commercial fat acids are produced fit for candles and soap.
Walther (*Exh.* 17.)	
Distils off volatile impurities from oil.	Does not distil anything from the fats.
Makes neutral oils suitable for burning in lamps. Makes no free fat acid or glycerine.	Decomposes neutral oils, and makes oily fat acids, incapable of burning in lamps, and glycerine.

Q. 137. State how many apparatuses for working complainant's process are set forth in complainant's patent, and whether or not the apparatus and mode of operation are in your opinion practicable; and whether or not they are sufficiently described to enable a person skilled in the arts to work the same.

A. There are two varieties or kinds of apparatus indicated. They are practicable and sufficiently well described to be worked by one reading the patent.

402 Q. 138. What do you regard as the distinguishing feature of Mr. Tilghman's process as patented, and on what do you base your opinion as to the practicability and sufficiency of the descriptions contained in his patent.

A. The distinguishing feature is the decomposition of fats into fat acids and glycerine by water at a high temperature and pressure. As to the practicability and sufficiency, my knowledge is derived from direct experiments with both forms of apparatus indicated in the patent.

Q. 139. Please state what experiments you have tried; when and in whose presence; and with what results. Describe the apparatus, what means you adopted for fixing the temperature, and state with whom you deposited samples of this product.

A. I tried the first apparatus named in the patent in presence of Dr. F. Genth and Gen'l B. C. Tilghman, the details of which have already been described in my answers to questions 36 and following.

I tried the second apparatus indicated in the patent with said apparatus quite similar to the drawing accompanying the specification to Mr. Tilghman's patent, except that the coil was circular, rising in a continuous spiral coil from below upwards, so that the exit pipe came from the

upper part instead of the lower, as indicated in said drawing. There was a force-pump drawing an emulsion of melted fat and water from a vessel in which it was heated and agitated, and forcing it into the coiled tube, which was heated by a fire to about the melting point of lead. The exit pipe outside the heating apparatus formed another shorter coil, which was cooled by water to below 212° F., and terminated in a final exit pipe which was controlled by a weighted valve. The pipe of the whole coil had a full inch exterior, and a full half inch interior, diameter. The temperature was determined by three tubes closed at their lower ends, abutting against the outside of the heated coil, and containing, respectively, bismuth, lead, and saltpetre. The temperature was shown during the working, by the saltpetre being never melted, the bismuth melted all the time, and the lead melted nearly the whole time, except during a few minutes of solidification. The weight on the exit valve was arranged to counterbalance the pressure in the coil, so that material would only flow out when the force-pump was worked. We measured nearly two gallons of pressed lard, and one gallon of water, which passed through the apparatus in less than an hour. I produced a specimen of the
403 pressed lard used, deposited it with the commissioner, as Exhibit V 1, in the suit of Richard A. Tilghman vs. Roland G. Mitchell, in equity, in the circuit court of the United States for the southern district of New York. I also produced a specimen of the product passed through the apparatus, which I deposited with the commissioner in the same suit marked V 2.

The fatty product from the apparatus ran out of the consistence of soft butter nearly the whole time. When it ran thinner a sample was taken, produced, and deposited, as Exhibit V 3, with same commissioner in same suit—it solidified on cooling. The aqueous liquid which separated on rendering a basin full of the product, that is, by keeping it melted for a short time, was evaporated and yielded glycerine, which was deposited as Exhibit V 4 in same suit.

The fatty matter which came through the apparatus was tested by hot alcohol, and found to dissolve entirely, and on cooling the solution very little unaltered fat separated from it. I estimated not one per cent. The pressed lard tried in the same way was almost wholly insoluble in alcohol. As pressed lard was used, and the product consisted of glycerine and crystallized fat acid, and matter from which mere traces of unaltered fat were obtained, the decomposition was practically complete.

I performed this experiment March 9th, 1864.

Q. 140. From the character of the results which you obtained, what is your opinion as to the practical utility of the process of Mr. Tilghman?

A. As we obtained at the rate of four hundred to four hundred and fifty pounds in twenty-four hours in so small an apparatus, and as the product consisted of fat acid and glycerine, I regard the process as a most perfect manufacturing process—that is, making fat acid and glycerine in an economical manner and adapted to commercial uses.

Q. What was the cubic capacity of this apparatus?

A. About eighty feet of coiled pipe, a half inch interior diameter, sixty feet of which were heated to about the melting point of lead. These sixty feet would hold three pounds and $\frac{11}{100}$ of fat, together with half as much water. Such a charge would remain in the coil about ten minutes at a time.

Q. 142. What is the chemical name of saltpetre, and why did you employ it as a test of temperature in connection with the lead and bismuth?

A. Its chemical name is nitrate of potash. I used it because
404 it melts at about 650° or 660° F., while lead melts at about 600° and bismuth at about 500°. Since the saltpetre was solid during the working of the apparatus described in the latter part of answer to question 139, while the bismuth was melted the whole time, and lead was melted the greater part of the time, except for a few moments at a time, I determined the temperature of the tubes to be that of melting lead.

Q. 143. Did you try any experiment to ascertain what would be the effect of heat alone on neutral fat at the temperature of melting lead?

A. I did. By putting a coil of thick lead wire into melted neutral fat in a test tube, and heating the tube until the lead was melted, there was a mere trace of decomposition as indicated by odor.

Q. 144. In the process of Mr. Tilghman, as tried by you, state whether any injurious results, in a practical point of view, in the formation of acroleine, were observed when it was worked at the temperature of melting lead.

A. None at all.

Q. 145. Please state when fat and water are heated together above the boiling point of water in any ordinary vessel, whether any circulation takes place; and if so, what is the character of such circulation, and what is the cause of it?

A. Such a circulation will take place, and the cause would be the rise of a heated and lighter column of liquid through the cooler and denser which takes its place, thus producing circulation. If water be heated from below and containing a layer of oil upon it, circulation would take place up to the boiling point of the water and even beyond that point; and if the stratum of oil were not disturbed, an accumulation of steam under pressure would burst through the stratum of oil, and throw up columns of liquid by jerks.

Q. 146. In the experiment tried by you in the coil apparatus, mentioned in Mr. Tilghman's patent, was there or not sufficient contact between the water and fat while in the coil to effect the required decomposition?

A. The product came out of the exit tube as a soft buttery fat without any separation of water; and as the fat and water were thoroughly mixed when they entered the apparatus, their contact must have been maintained throughout the coil.

Q. 147. Can you state, from your experiment with the coil apparatus of Tilghman, what would be its working capacity if the
405 length of coil were increased from eighty feet to the length exhibited in plaintiff's patent, the internal diameter of the tube being the same, to wit, half an inch?

A. From my measurement of the diameter of the tube given in plaintiff's drawing, accompanying the patent, together with the length of coils represented in the said drawing, as measured by the diameter of the tube in said drawing, taking such diameter as one inch as called for in the patent, the length of the coil in the patent drawing is not less than 288 feet. This being three and six tenths times as great as the length of coil in the apparatus I employed, and the product of the coil apparatus, estimated from the quantity I actually obtained, being 447 pounds of fat operated on and passed through the coil, the product of a coil 288 feet in length would be over 1,600 pounds in twenty-four hours.

Q. 148. In the second part of plaintiff's specification, in speaking of the coil apparatus, he says: "No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture."

Do you find that direction in that portion of the specification which describes the mode of operating the process with what he calls "any convenient vessel," and can you give any reason for a difference in the directions on this point?

A. I do not find that direction in the first part of the patent. In the second part of the patent it is necessary that the coil should be kept entirely full of the mixture, in order to the more steady and uniform working of the apparatus, for the presence of steam in the coil would cause an irregular and jerking action, which is not desired in a uniform and continuous operation. Although there is no express direction that the "convenient vessel" in the first part of the patent should be entirely filled, yet from the instructions given to secure an amount of pressure, to prevent conversion of water into steam, the patent implies that it should be reasonably filled, to prevent such conversion as far as practicable. There is no essential reason, however, why there may not be steam present in the apparatus in the first part of the patent. The patent does not claim any particular apparatus, but such in which a mixture of water and fat may be heated to a high temperature and corresponding pressure, water being always present to cause the decomposition of the fat into fat acids and glycerine, which last is dissolved in the water. The reason why the special instruction to keep the coil entirely full is not given in relation to the "convenient vessel," is
406 that the operation is intermitting and not continuous, and therefore no such jerking effect would take place as when steam is allowed in the coil. The essential conditions of the "convenient vessel" and of the coil are that they decompose fatty bodies into fat acids and glycerine, by the action of water, at a high temperature and pressure.

Q. 149. Have you made any experiments to carry into literal execution the first described method mentioned in Tilghman's patent? If so, state the details when said experiments were made, and with whom you deposited samples of the product.

A. I made such an experiment on the 23d of March, 1864, in Philadelphia by enclosing several ounces of pressed lard, with half as much water, in an iron tube lined with copper, tightly closing the same, and subjecting the mixture to the temperature of melting lead for forty minutes without disturbing the vessel during that time, then cooling it rapidly with cold water, and pouring out the contents. I produced Exhibit R 1, as a sample of the glycerine-water, as poured out from the tube and through filtering paper after rendering the mixed fat acids and glycerine-water, and deposited it with the commissioner in said suit against Mitchell. The glycerine-water was subjected to no other process. I deposited Exhibit R 2, in the same suit, as a specimen of the fat acids rendered in this operation, and which had received no other treatment. I deposited in the same suit Exhibit R 3, as another portion of the rendered fat acid of this operation, settled or clarified by dilute sulphuric acid, and which has received no other treatment.

Q. 150. How did you ascertain the temperatures employed in this experiment?

A. By placing on the top of the tube small pieces of bismuth, lead, and saltpetre. During the operation the bismuth remained melted, the saltpetre was never melted, and the lead was kept continually at a temperature between solidity and fluidity, the heat being regulated so as to maintain it at the melting point of lead.

Q. 151. State whether in the result of this experiment there was acroleine produced; and if so, in what quantity?

A. There was so little produced, if any, that I was uncertain whether the slight odor observed was due to acroleine or to some pyrogneous product. If appreciable quantities had been produced they would have had the usual effect of such quantities, by causing pain to the eyes and a flow of tears. Not the slightest effect of this kind occurred.

407 Q. 152. Have you made any experiments on the practical mode of purifying and pressing the fat acids produced in your trial of Tilghman's coil apparatus? If so, describe such experiments, and state with whom you deposited samples of the products.

A. I rendered a quantity of the fat acids obtained by me with the coil apparatus, by boiling by means of steam with dilute sulphuric acid, and allowing the fat acids floating on the aqueous liquid to cool to a solid mass. I deposited Exhibit Q 1 as a sample of such cooled solid mass, in said Mitchell suit, with the commissioner. A portion of the solid mass was subjected to cold pressure and then to warm pressure between copper plates to remove the fluid fatty matters, and the remainder consisting of solid fat acids was cast into a glass tube and deposited with the commissioner in the same suit, as Exhibit Q 2. Another portion of such solid fat acids was cast into a porcelain crucible and deposited with the commissioner in said suit, as Exhibit Q 3.

Q. 153. Can you state, of your own knowledge, whether the working of Tilghman's coil apparatus produces fat acids fit for making candles, and glycerine fit to be sold as a commercial product after purification by the ordinary methods?

A. By comparing the solid fat acids obtained by the coil apparatus, and subsequent clarification and pressure, with the solid fat acids obtained in Grant's candle factory, in Philadelphia, by the sulphuric saponification, I believe that the product of the coil apparatus is fit for making candles. By comparing the glycerine which I obtained by the coil apparatus with several kinds of glycerine of commerce, I believe that the coil apparatus will make a glycerine suitable for commercial purposes, equal to that produced by any other process, after resorting to the usual method of purification.

Further examination of this witness adjourned to Thursday, February 25th, at 9½ o'clock, a. m.

408 THURSDAY, *Feb. 25th*, 9½ *a. m.*

Present: B. C. Tilghman, esq., for complainant; Charles B. Collier, esq., for defendants.

Examination of James C. Booth resumed:

Q. 154. Please state whether you have seen the purification of dark-colored fat acids accomplished by distillation? State how said discolored acids were obtained.

A. I witnessed the operation of Grant's candle factory, in Philadelphia, where the commercial fats are treated with sulphuric acid by a high heat by superheated steam, and subsequent washing with water. Samples of the fatty matters were drawn off after such washing and examined. The discoloration of the fat acids is doubtless due to a decomposing action of sulphuric acid, as that is one of the usual effects of sulphuric acid on organic matter.

Q. 155. Please state whether in said process of distillation acroleine is or not produced, and in what quantities. State, also, whether the candles produced by the process appear to be in any way injured by said acroleine?

A. Acroleine was disengaged in the operation in quantity, but as the candles produced by the operation were of the best quality, the candle stock was evidently not affected by such acroleine.

Q. 156. Examine defendants' Exhibit 8, from Payen's Chemistry, page 771, and the context, and state whether the process there described is, or is not, the same as that witnessed by you at Grant's factory.

A. It is the same as there described.

Q. 157. Can you state, from what you saw of the working of that process at Grant's factory, whether the separation of glycerine mentioned in defendants' Exhibit 8 takes place in the state of glycerine, or altered into acroleine by the heat used in the process?

A. A portion at least of the glycerine was decomposed into acroleine; and I inferred the quantity to be considerable from the abundant odor of acroleine.

Q. 158. From your experience in heating neutral fatty bodies, do you consider that the temperature at which their glycerine decomposes into acroleine is a fixed and invariable point, or do you consider it to depend upon the conditions as to pressure and currents of vapor or air, as modifying the effect of the heat?

409 A. I have heated neutral fats to a temperature of about 600° F., confined and under pressure, without the production of sensible quantities of acroleine; and as I have heated them to the same temperature, confined but not under pressure, and have also heated them to lower points of temperature with the production of large quantities of acroleine in both these last cases, I consider that the decomposition of glycerine takes place at variable points of temperature, depending upon varying conditions of pressure and currents of vapor or of air.

Q. 159. Do you understand the kind of apparatus, and method of working, used by N. Ropes, of Cincinnati, in 1860 and 1863, for the manufacture of fat acid and glycerine? If so, state how you obtained your knowledge.

A. I have read the depositions of N. Ropes, in the suit of R. A. Tilghman vs. M. Werk, and in the suit of R. A. Tilghman vs. R. G. Mitchell, and understand from them his mode of working and the kind of apparatus he uses.

Q. 160. Supposing that the drawing now produced marked Complainant's "Exhibit," Booth 3, is a representation of Ropes' apparatus, state whether you are acquainted with any forms of apparatus commonly known and used in the arts prior to 1854, which resemble the apparatus used by Ropes; if aye, produce the publications, and state how those apparatuses compare with Ropes' apparatus in their mode of producing circulation or mixture of the fat and water.

A. I am acquainted with several, with some from inspecting publications in which they are described, and with some from inspection and trial of the apparatus. One is contained in Morfit's Chemistry, applied to the manufacture of soap and candles, published, Philadelphia, 1847; where on page 231 is a similar arrangement, of paddles on a horizontal shaft revolving in a cylinder. I refer also to the apparatus described and drawn in Radley and Myer's English patent, No. 13081, dated May 25, 1850. I also refer to De Milly's patent, 1834, described in Roret's Encyclopedia, Paris, 1849, page 114; consisting of cross-pieces at the end of a vertical plunger termed an agitator. I also refer to the common barrel-churn with revolving wings.

Q. 161. Could or could not the decomposition of fat into fat acids and glycerine, by the action of water at a high temperature and pressure, be performed in any and which of said commonly-known apparatus, if

made of suitable strength and materials, as well as in the apparatus used by Ropes?

410 A. Such decomposition could be performed in each of the apparatuses named, because all the conditions required in Ropes' apparatus are embraced in each of them.

Q. 162. If the manufacture of fat acids and glycerine were performed in any of said commonly-known forms of apparatus by the action of water, would the same saving of lime and sulphuric acid be realized as in Ropes' apparatus?

A. The same saving would take place as with Ropes' apparatus, because the conditions are the same, as stated in the last answer.

Q. 163. Do you understand the kind of apparatus and method of working used by C. T. Jones, of Cincinnati, in 1864, for the manufacture of fat acids and glycerine? If so, state how you obtained your knowledge.

A. I have read the deposition of C. T. Jones, in the suit of R. A. Tilghman vs. R. G. Mitchell, and understand from it his method of working and the kind of apparatus he uses.

Q. 164. Supposing that the drawing now produced marked Complainant's Exhibit, Booth 4, is a representation of Jones' apparatus, state whether you are acquainted with any forms of apparatus, commonly known and used in the arts prior to 1854, which resemble Jones' apparatus in the method of causing a mixture or circulation of water with other substances; if so, produce the books, and explain the points of resemblance.

A. I am acquainted with several. In Bertholet on Dyeing, London, 1824, Vol. I, second plate, circulation is produced by a pump inside of a vertical boiler, the pump drawing water from the bottom and spreading it on the top in drops; also in Ure's Dictionary, edition of 1839, page 138, a pump is similarly arranged outside of the boiler. Alliott's English patent, No. 13490, February 3, 1851, exhibits a revolving centrifugal pump inside of a vertical boiler, which draws water from the bottom and spreads it on the top.

Q. 165. Supposing the several apparatuses you have just described to be made of suitable strength and materials to resist the requisite heat and pressure, could the manufacture of fat acids and glycerine by the action of water on fat at a high temperature and pressure be carried on in said apparatus?

A. It could, because the essential conditions of fat, water, high temperature, and pressure, are embraced in the apparatus mentioned in the last answer.

Q. 166. In that case would the same saving of lime and sulphuric acid be effected as in operating the Jones apparatus?

411 A. It would, because the essential conditions are the same.

Q. 167. Examine the sheet of drawings now produced marked Complainant's Exhibit, Booth 5, and state whether you have verified the substantial accuracy of the said drawings, and the descriptions and dates thereto appended, by comparing them with the original publications therein referred to.

A. I have done so, and find them all correct.

Q. 168. Explain how Figure 1 on such exhibit compares in its method of operation with Figures 2, 3, 4, and 5.

A. They all consist in agitating a mixture of water and fatty matters. Nos. 1, 2, 3, and 5 with a view of more intimate mixture. Nos. 1 and 3 require the use of an elevated temperature and pressure.

Q. 169. Explain how Figure 6 compares with Figures 7, 8, and 9 in their method of operation.

A. They all consist in raising a liquid from the bottom to the top of a vessel by an ordinary pump or centrifugal pump, there to distribute it and let it descend to the bottom, to be again raised up.

Q. 170. Supposing the apparatus designated as Figures 2, 3, 4, 5, 7, 8, 9, to be made of suitable strength and materials, could or could not the manufacture of fat acids and glycerine, by the action of water on fats at a high temperature and pressure, be carried on in any of said apparatuses?

A. It could be conducted in any one of them, because the essential conditions of fat, water, high temperature, and pressure would be embraced in each of them.

Q. 171. In that case would or would not the saving of lime and acid be the same as if the manufacture had been carried on in the apparatus used by Ropes or by Jones?

A. The saving would be the same because the essential conditions would be the same.

Q. 172. Referring to the directions contained in complainant's patent, "that the requisite amount of pressure should be applied to prevent the water being converted into steam," and the whole of the specification taken in connection therewith, do you, as an expert in chemistry and chemical manufacture, understand therefrom that the pressure of steam is prohibited as injurious, and that steam would prevent or hinder the desired action from taking place between the water and fat; or do you understand that the bulk or mass of the water is to be prevented from being converted into steam, and that its presence in sufficient quantity as liquid water is the object to be secured by applying pressure?

412 (Question objected to as being leading and argumentative.)

A. Throughout the whole patent an intimate mixture of fat and water is referred to as the essential condition of the process, and the efficient chemical agent is water at a high temperature and pressure. I understand the directions "to prevent the water being converted into steam" to mean that the main body or principal part of the water should be retained as water in a liquid state, mixed with the fat in order to decompose it, and that sufficient pressure should be applied to prevent the water escaping as steam, and thereby ceasing to be mixed with the fat. I do not find it anywhere stated or implied in the specification that the presence of steam will hinder or prevent the decomposition of the fat by the water. The direction "that no air or steam should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture," refers only to the coil apparatus. The working of this should be continuous and regular, in order that each part of the mixture of fat and water should become gradually heated, should be retained a sufficient time at a proper heat, and should then be gradually cooled before it escapes from the safety-valve. If the tubes were allowed to become partly emptied of the mixture the empty space would be instantly filled with steam, rising from the water of the mixture in the hottest part of the tube, and part of the fat would thus be left without its proper quantity of water, and would not be satisfactorily decomposed. Also, supposing any considerable part, say one-half, of the tube to be kept constantly empty for any length of time, the feed of the pump remaining the same, the mixture would rush rapidly through, and would, therefore, remain in the tubes, and be exposed to the heat only half the length of the time calculated on. The necessary conditions of

the process as to the mixture of the fat and water, and length of time at the proper heat, being thus neglected, the operation would be irregular, and the decomposition of the fat would be incomplete.

Q. 173. Examine the paper now produced, marked Complainant's Exhibit, Booth 6, and state whether you have compared it with the printed official alphabetical index of patentees of inventions in England from March 2, 1617, to October 1, 1852, London, 1854, and state whether it is a correct copy of all the entries in said index of patents, in the names of James Collier and of Nicholas Hegesippe Manicler, respectively.

(Question objected to for the reason that said patents are not referred to in defendants' answer, except No. 5345, (defendants' Exhibit No. 15,) and the same are therefore irrelevant in this case.

413 A. I have compared that paper with the index referred to, and find that it is a correct copy of all the entries in said index in the names of James Collier and Nicholas Hegesippe Manicler, respectively.

Q. 174. Examine the paper now produced marked Complainant's Exhibit, Booth 7; state whether you have compared it with the official subject-matter, index of English patents from March 2, 1617, to October 1, 1852, London, 1854, vol. 2, page 551, under head of "making, refining, and treating oils," and state whether it is a correct copy of all the entries therein contained of patents for making, refining, and treating oils, granted to James Collier and Nicholas Hegesippe Manicler.

(Objected to by defendants' counsel for reasons stated in last objection, and for the further reason that the introduction of such testimony is a useless encumbering of the record.)

A. I have compared that paper with the index referred to, and find that it is a correct copy of all the entries in said index of patents to N. H. Manicler and James Collier, for making, refining, and treating oils.

Q. 175. Examine the comparison between defendants' process and complainant's patent, made in parallel columns in defendants' supplementary answer, and attach thereto in a third column any explanation of the alleged points of difference.

A. I would explain the alleged points of difference as follows:

PLAINTIFF'S PATENT.	DEFENDANTS' PROCESS.	EXPLANATION.
"I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of these bodies to combine with water, and thereby obtain, at the same time, free fat acids and a solution of glycerine."	Consists of two distinct operations: 1. The fat is subjected to the action of milk of lime, steam-heat at a low pressure in a close tank. 2. The product of this treatment is an acid lime-soap, which must be subjected to the action of sulphuric acid; without such second process it could not be used for candle-stock.	Defendants' first operation really consists of two distinct processes. His milk of lime consists of one part lime to eleven parts water; the lime acts first upon 4-10 of the fat, making lime-soap; the water, heated to 85 lbs. pressure, then acts upon the remaining 6-10 of the fat, making free fat acids.
414	Fatty body mixed with the milk of lime, and heated by an application of steam heat to about 310° F.	Both chemical analysis and mechanical pressing show that defendants' product consists of about 42 parts of lime-soap and 58 parts of free fat acids.

I mix the fatty body to be operated upon with from a third to half its bulk of water; and the mixture may be placed in any convenient vessel in which it can be heated to the melting point of lead (612° F.) until the operation is complete.

The operation is not completed until the mixture has been drawn off into a separate tank and treated with sulphuric acid.

Complainant's process is not confined to any particular temperature. The decomposition becomes more rapid as the heat is increased.

The vessel must be closed, and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of water into steam.

The vessel is so closed as to contain steam, and steam is, during the process, actively circulating in the vessel, and through and above the mixture, in large quantities.

In defendants' vessel 85 lbs. pressure is applied, and does prevent the mass or body of water from being converted into steam.

Plaintiff's pressure is directed in order to insure the presence of water in a liquid state by preventing its escape as steam.

No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture.

The vessel is only filled with the mixture about three-fourths of its capacity, steam occupying all the rest of the space in the tank. If the tank was full the operation would fail.

Plaintiff's directions that no steam or air should be allowed in the tubes refer merely to details of working that particular form of apparatus, and not to the essential conditions of the process.

Defendants' vessel contains fat mixed with water at a high temperature and pressure, and the fat is thereby converted into fat acid and glycerine, which is the essential feature of plaintiff's process.

The presence or absence of steam makes no difference in the chemical action between the fat and water, and is entirely immaterial.

415 The mixture, while flowing through them, (the tubes,) should be maintained at the desired temperature for ten minutes before it passes into the refrigerator.

The mixture is subjected in one mass to the desired temperature for 8 to 10 hours, and then allowed to stand from 8 to 24 hours in the digester, no refrigerator employed, nor tubes for any purpose other than the induction and outlet of steam.

Ten minutes are directed for the heat of 612° F. The length of time required increases as the heat is diminished.

The melting point of lead (612° F.) has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matter into fat acids and glycerine takes place with some materials (such as palm-oil) at or below the melting point of bismuth, (510° F.)

The maximum heat employed for the treatment of the hardest fats, such as tallow, 310° F., is 130° F., less than the minimum mentioned in the plaintiff's patent (440° F.) for vegetable oils or fats.

Plaintiff's process is not confined to any particular temperature or form of apparatus, but to the making of fat acids and glycerine from fats by the action of water at a high temperature and pressure.

Defendants prefer to do this at a less high degree of temperature and pressure, and to take a longer time.

To indicate the temperature I have found the successive melting of metals, etc., to be convenient in practice. The series I have used consists of tin melting at 440° F.; bismuth at about 510° F.; lead at about 612° F.: and nitrate of potash at about 660° F.		The chemical action or essential feature of the process is the same at the lower as at the higher temperature; it is only proportionately slower.
I deem it prudent to test the strength of the apparatus by a pressure of 10,000 lbs. to the square inch before taking it into use, but I believe that the working pressure necessary in using the heat I have mentioned will not be found to exceed 2,000 pounds to the square inch.	The apparatus of the defendants is subjected to a pressure due to a temperature of about 310° F., which is about 85 lbs. to the square inch, or 1,915 lbs. less to the square inch than the "working pressure," according to the direction of the plaintiff's patent.	These directions refer to a particular form of apparatus which forms no part of plaintiff's invention. The pressure per square inch, in any apparatus in which fat and water are heated, will, of course, be proportionate to the temperature.
416 The hot mixture of fat acids and solution of glycerine, which escapes from the exit-valve of the apparatus, separates by subsidence. The fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means. The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soap, etc.	None of the mixture escapes from the defendants' apparatus. It does not and cannot separate into fat acid and solution of glycerine by subsidence, and could not be used in the manufacture of candles and soap, &c., in the state in which it is removed from the tank, nor could any part of it be so used.	The solution of glycerine does separate, by subsidence, from defendants' product of fat acids, mechanically mixed with lime-soap. The subsequent treatment of the mixture with sulphuric acid takes effect only on the lime-soap portion, and not on the fat acid portion, the amount of sulphuric acid used being governed wholly by the amount of lime used. Plaintiff's fat acids are directed to be used "like those obtained by other methods," and are to be bleached and purified by the ordinary processes.
Some fatty bodies (particularly when impure) generate during the process a portion of acetic or other soluble acid, which would tend to injure the iron tubes. In such cases I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes.	The defendants have not manufactured fat acids and solution of glycerine by the action of water at a high temperature and pressure, but have manufactured acid lime-soap, but no free fat acids by the combined action of milk of lime, steam heat, and pressure. They have not used lime or other alkali for the purpose stated in the plaintiff's patent, but for the express and sole purpose of decomposing the fat, the decomposing power of the lime being enhanced by the action of the steam.	The use of alkaline matter with the fat and water is not claimed by plaintiff as part of his invention. It is a mere matter of convenience with the manufacturers, and can be used or omitted at pleasure. The action of defendants' lime is not "enhanced by the steam," but, after the lime has combined with its full equivalent quantity of fat, the action of the highly-heated water decomposes the remainder of the fat into fat acids and glycerine. Defendants' infringement consists, not in his using some lime, but, on the contrary, in his not using lime enough to saturate all the fat, and then using the chemical action of highly-heated water to decompose the rest of the fat.

417

Whatever quantity of lime is used removes an equivalent quantity of fat from the decomposing influence of the highly-heated water. The lime, being the stronger agent, helps itself first, and, until it is satisfied, the peculiar action of the highly-heated water cannot begin.

What defendants call "acid lime-soap," is really a mechanical mixture of neutral lime soap and free fat acids.

Examination adjourned to 2 o'clock p. m. of this day.

THURSDAY, *Feb. 25th, 2 p. m.*

Present: B. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

(The defendants having given notice of offering in evidence the paper marked Defendants' Exhibit No. 20, and objection thereto being offered by complainant's counsel, the following questions are put to the witness de bene esse and under protest.)

Examination of James C. Booth resumed:

Q. 176. Examine paper now produced, marked Defendants' Exhibit No. 20, being notice of Austrian patent to William Charles Hirschfeld. State whether it contains any evidence of a prior knowledge or use of complainant's process, and explain wherein the processes there described resemble or differ from complainant's process.

A. That paper does not contain any evidence of a prior knowledge or use of complainant's process, inasmuch as it does not mention the decomposition of fats into fat acid and glycerine by the action of water at a high temperature and pressure. It describes a Papin's digester, containing an inner vessel of le. l, with a space of ¾ of an inch between the two vessels; this space is kept filled with water, so as to form a
418 water-bath or jacket for the inner vessel. Two processes are described as being used. First, raw tallow finely cut up is put into the inner vessel with rain-water or with very dilute sulphuric acid. The digester is then closed and heated for two hours; the tallow is then taken out, filtered, and pressed. It is not stated that any fat acid or glycerine is produced, but, on the contrary, the product is expressly and repeatedly stated to be "tallow." As to the second process it is stated "but if the tallow is to be decomposed at the same time," one hundred weight of raw tallow, two pounds of sulphuric acid, and thirty-two pounds of rain-water are to be put into the inner vessel and treated as "mentioned above," and "the rendered decomposed mass" is then to be filtered and pressed. No other description of the product is given. It is evident that the decomposition of the tallow, which takes place in the second process, and not in the first, must be caused by the two per cent. of sulphuric acid, which is used in the second process, and which is the only difference between it and the first process. The distinction is plainly pointed out between the first process, in which only "rain-water or very dilute sulphuric acid" is used, and which produced only "tallow" or "pure or purified" tallow, and the second process, in which

two per cent. of sulphuric acid is used, and which produces "decomposed" tallow. What this "decomposed tallow" was is left for inference or conjecture. It is nowhere stated to be fat acids. So also it is left for conjecture whether any or what high temperature and pressure were employed in the digester, as nothing definite is said on the subject.

The first process differs from complainant's in that it produces tallow and does not produce fat acid and glycerine. The second process differs from complainant's in that the chemical agent used to decompose the tallow is sulphuric acid, whereas in complainant's process the chemical agent is water at a high temperature and pressure. It differs also from complainant's process in that it is not stated to produce fat acids and glycerine.

(Complainant's counsel here offers in evidence complainant's patent, dated 3d of October, 1854, No. 11766, and the certificate of extension thereof, dated 23d November, 1867.)

(Also the books mentioned by the witness in his answers to interrogatories numbered 68, 69, 70, and 71, and 104.)

Q. 177. If you have a sample of the dry solid product left between the papers by the mechanical squeezing of defendants' acid lime-
419 soap product of December 17, 1868, as mentioned in your answer to interrogatory No. 53, please produce the same and deposit it with the commissioner.

A. I have such a sample and here produce it.

(Sample is marked by commissioner, Complainant's Exhibit, Booth 8.)

(It is agreed by and between the parties to this suit and their respective counsel, that the three sets of samples, received by the witness, Professor Booth, from Cincinnati, and which are referred to by him in his answer to the 60th interrogatory, were sent by the defendants as samples of the product of their processes, as described in their original and supplemental answers filed, but that the acid lime-soap products of the first and second set of said samples were discovered by defendants to be incomplete or imperfect after the same had been sent.)

Cross-examined by Charles B. Collier, esq.:

X Q. 178. Were not all the questions, which have been asked you by the counsel for the complainant prepared in writing, and submitted to you prior to commencing the taking of your deposition in this cause?

A. The greater part of them were.

X Q. 179. Were not all of the answers given to said questions, as embraced in your examination-in chief, prepared before you were sworn as a witness herein?

A. The greater part of them were.

X Q. 180. Have not all of such previously-prepared questions been read to you by the counsel for the complainant, and have not such previously-prepared answers thereto been read by you from manuscript or printed documents in giving your testimony-in-chief herein?

A. They were so read to me, and the answers were so read by me.

X Q. 181. Were not all and each of your said answers submitted to the complainant or his counsel, or both, prior to the commencement of your deposition in this cause?

A. I am not aware that the complainant has ever seen them. I do not remember submitting them to complainant's counsel before reading them here, except in a few instances.

X Q. 182. To whom, if any one, have they been submitted?

A. To no one, except in some instances to complainant's counsel.

420 X Q. 183. Will you annex as an exhibit hereto the manuscript from which you have read, as stated, your answers?

A. I here produce the manuscript as requested.

(Marked by commissioner, Defendants' Exhibit, X Ex. Booth 1.)

The answers, given in the examination, vary in some instances from those written in the last exhibit, the true answers being contained in the examination-in-chief.

(The counsel for respondents does now enter his objection and protest to the introduction of the foregoing deposition, for the reason that the same appears as stated by the witness to have been prepared and given in a manner contrary to the established rules regulating the taking of testimony, and contrary to public policy; and thus protesting, counsel proceeds to cross-examine the witness.)

X Q. 184. You have stated in your examination-in-chief that two forms of apparatus are contemplated by the complainant for carrying into effect his process; will you refer to the language in his said letters-patent referring to the first form of apparatus contemplated by him?

A. The essential point of the patent is the subjection of "fatty or oily bodies to the action of water at a high temperature and pressure," so as to "obtain thereby at the same time free fat acid and solution of glycerine." The specific high temperature and pressure are not stated. To show how this essential point may be carried out in practice, it is stated in the patent that the fatty body and water "may be placed in any convenient vessel in which it can be heated to the melting point of lead," and this is the first apparatus noticed in the patent.

X Q. 185. Will you refer to the first paragraph in the letters-patent in which the second form of apparatus is mentioned, and quote the first sentence of such paragraph?

A. "The process may be performed more rapidly and also continuously by causing the mixture of fatty matter and water to pass through a tube or continuous channel, heated to the temperature already mentioned, the requisite pressure for preventing the conversion of the water into steam being applied during the process, and this, I believe, is the best mode of carrying my invention into effect."

X Q. 186. The words now quoted from said patent, to wit: "the vessel must be closed and of great strength, so that the requisite
421 amount of pressure may be applied to prevent the conversion of the water into steam," refer to the form of apparatus first mentioned in the patent, do they not?

A. As they follow the mention of "any convenient vessel," they might be supposed to refer to such convenient vessel, such first apparatus, but as the sentence quoted embraces the requisite conditions of the essential feature of the patent in whatever apparatus the process may be conducted, the passage quoted may not necessarily refer to the first-named apparatus of the patent.

X Q. 187. You have referred to, have you not, and quoted in answer to X Q. 185, the first paragraph referring to the second form of apparatus mentioned by the patentee, to wit, the tube apparatus. Does not the quotation in the last question, X-q. No. 186, precede the paragraph referring to the second form of apparatus?

A. I quoted that paragraph in answer to X-q. No. 185. The sentence quoted in question X 186 is the last sentence of the paragraph preceding the quotation in answer to X-q. 185.

X Q. 188. Do you understand that the direction that "the vessel must be closed and of great strength, so that the requisite amount of press-

ure may be applied, to prevent the conversion of the water into steam," applies to both forms of apparatus or to one only; if to one, which?

A. My view is, that it applies to any vessel whatever in which the essential feature of the patent can be carried out, namely, the decomposition of fat by the action of water at a high temperature and pressure, so as to form free fat acids and glycerine, and if to any vessel therefore to the two named in the patent, as well as to others, and not to any one in particular.

X Q. 189. You understand, therefore, do you not, that, in any form of apparatus in which the complainant's process is practiced, the conversion of the water into steam must be prevented?

A. Practically it must be prevented.

X Q. 190. What do you mean by the word practically?

A. I mean that the vessel should be so filled with the mixture of fat and water, as to allow of the expansion of the mixture on being heated, to avoid the danger of bursting the vessel. In the tube apparatus, the tube should be completely filled to render the process continuous and more perfect.

X Q. 191. Can you refer to and quote any paragraph in the letters-patent of the complainant, indicating that the apparatus,
422 whatever its form may be, should not be closed, and of such strength as that the conversion of water into steam should be prevented; if so, will you make such reference?

A. I know of no paragraph which states that the apparatus should not be closed, and of such strength that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

X Q. 192. What allowance would you make for steam room in the vessel, should you undertake to practice the complainant's process according to his patent?

A. If I were a manufacturer, I could ascertain it by a very simple experiment, by determining the amount of expansion of a mixture of fat and water by heat.

X Q. 193. Would you allow any steam room in the vessel? If so, why would you do so?

A. I would allow so much space above the charge of fat and water as to permit the expansion of the mixture when heated, and for the sake of the expansion.

X Q. 194. You would make no such allowance, would you, in using the coil apparatus?

A. I would not.

X Q. 195. Will you look at the English letters-patent of the complainant now shown you and annexed hereto, marked Defendants' Exhibit, X Ex. Booth 2, and quote the language from said letters-patent, referring to the treatment of fatty matters for *for* the purpose of manufacturing soap, particularly that portion thereof specifying the degree of heat required in conducting such process?

A. The language is as follows: "The degree of heat required is less than that which is necessary to procure free fat acid, and should generally be kept between the melting points of tin and bismuth. At about 340° Far. the neutral fats will form soaps with the solutions of alkaline carbonates, but a higher temperature will produce the result more quickly." This quotation refers to the use of the coil apparatus, as is mentioned in the following words: "The apparatus, before described, for producing the fatty acids and glycerine by a continuous process, may be used for the production of soap in a similar manner," and in the following, "the carbonic acid expelled" "issues from the exit-valve."

X Q. 196. You understood from said English letters-patent, do you not, that a higher degree of heat is required for the production
423 of free fat acid, by the action of water, than is employed in the treatment of fatty matters for the manufacture of soap?

A. The passage quoted refers exclusively to the coil apparatus, in which it is stated that free fat acids may be made from a mixture of fats and water at the temperature of melting lead, say about 600° Far., and that a soap may be made in the same apparatus at about 440° to 500° F., and therefore at a lower temperature.

X Q. 197. Do you think that a change in the form of apparatus would affect the relative degree of heat required for the production of free fat acids by the action of water, and for the manufacture of soap? If so, give your reasons for the conclusions that you may state.

A. In any apparatus suitable for the purposes mentioned in the patent, I believe a lower temperature may be used for making soap than for decomposing into fat acids and glycerine by the action of highly-heated water, because the chemical action of the alkaline matter used to make the soap would facilitate the decomposition of the fat.

X Q. 198. If, then, in the manufacture of soap from fatty bodies with water and a "carbonated alkali," the degree of heat "should generally be kept between the melting points of tin and bismuth," the degree of heat in the production of "free fat acids" by the action of water should be greater than "between the melting points of tin and bismuth," should it not?

A. It should in the use of the coil apparatus for a continuous and quick action, and no other apparatus for the soap production is mentioned in the English patent.

Examination adjourned to to-morrow (Friday) morning at 9½ o'clock

FRIDAY, *February* 26, 9½ *o'clock a. m.*

Present: B. C. Tilghman, esq., for complainant; Chas. B. Collier, esq., for defendants.

Cross-examination of James C. Booth, resumed:

X Q. 199. Does not the English letters-patent of the complainant state specifically that the degree of heat required for the manufacture of soap is less than that which is necessary to produce free fat acids? Will you answer yes or no?

424 A. Yes; the patent so states it, referring to the coil apparatus.

X Q. 200. Quote the language of the patent referring in that connection to the coil apparatus.

A. It is contained in the patent under the second part of the invention for making soap with fatty matters and carbonated alkali, under which the following are the words, "And for this purpose the apparatus hereinbefore described for producing the fatty acids and glycerine by a continuous process may be used for the production of soap in a similar manner." The contin'ous process is described under the first head of the patent, under the following words, on page 3 of the printed copy of English patents. "The process may be performed more rapidly, and also continuously, by causing the mixture of fatty matter and water to pass through a tube or continuous channel," &c.

X Q. 201. Do you understand that the words, "And for this purpose the apparatus hereinbefore described for producing the fatty acids and glycerine by a continuous process may be used for the production of soap in a similar manner," restrict the operator to the use of the coil apparatus in the manufacture of soap?

ure may be applied, to prevent the conversion of the water into steam." applies to both forms of apparatus or to one only; if to one, which?

A. My view is, that it applies to any vessel whatever in which the essential feature of the patent can be carried out, namely, the decomposition of fat by the action of water at a high temperature and pressure, so as to form free fat acids and glycerine, and if to any vessel therefore to the two named in the patent, as well as to others, and not to any one in particular.

X Q. 189. You understand, therefore, do you not, that, in any form of apparatus in which the complainant's process is practiced, the conversion of the water into steam must be prevented?

A. Practically it must be prevented.

X Q. 190. What do you mean by the word practically?

A. I mean that the vessel should be so filled with the mixture of fat and water, as to allow of the expansion of the mixture on being heated, to avoid the danger of bursting the vessel. In the tube apparatus, the tube should be completely filled to render the process continuous and more perfect.

X Q. 191. Can you refer to and quote any paragraph in the letters-patent of the complainant, indicating that the apparatus,
422 whatever its form may be, should not be closed, and of such strength as that the conversion of water into steam should be prevented; if so, will you make such reference?

A. I know of no paragraph which states that the apparatus should not be closed, and of such strength that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

X Q. 192. What allowance would you make for steam room in the vessel, should you undertake to practice the complainant's process according to his patent?

A. If I were a manufacturer, I could ascertain it by a very simple experiment, by determining the amount of expansion of a mixture of fat and water by heat.

X Q. 193. Would you allow any steam room in the vessel? If so, why would you do so?

A. I would allow so much space above the charge of fat and water as to permit the expansion of the mixture when heated, and for the sake of the expansion.

X Q. 194. You would make no such allowance, would you, in using the coil apparatus?

A. I would not.

X Q. 195. Will you look at the English letters-patent of the complainant now shown you and annexed hereto, marked Defendants' Exhibit X Ex. Booth 2, and quote the language from said letters-patent, referring to the treatment of fatty matters for the purpose of manufacturing soap, particularly that portion thereof specifying the degree of heat required in conducting such process?

A. The language is as follows: "The degree of heat required is less than that which is necessary to procure free fat acid, and should generally be kept between the melting points of tin and bismuth. At about 340° Far. the neutral fats will form soaps with the solutions of alkaline carbonates, but a higher temperature will produce the result more quickly." This quotation refers to the use of the coil apparatus, as is mentioned in the following words: "The apparatus, before described, for producing the fatty acids and glycerine by a continuous process, may be used for the production of soap in a similar manner," and in the following, "the carbonic acid expelled" "issues from the exit-valve."

X Q. 196. You understood from said English letters-patent, do you not, that a higher degree of heat is required for the production
423 of free fat acid, by the action of water, than is employed in the treatment of fatty matters for the manufacture of soap?

A. The passage quoted refers exclusively to the coil apparatus, in which it is stated that free fat acids may be made from a mixture of fats and water at the temperature of melting lead, say about 600° Far., and that a soap may be made in the same apparatus at about 440° to 500° F., and therefore at a lower temperature.

X Q. 197. Do you think that a change in the form of apparatus would affect the relative degree of heat required for the production of free fat acids by the action of water, and for the manufacture of soap? If so, give your reasons for the conclusions that you may state.

A. In any apparatus suitable for the purposes mentioned in the patent, I believe a lower temperature may be used for making soap than for decomposing into fat acids and glycerine by the action of highly-heated water, because the chemical action of the alkaline matter used to make the soap would facilitate the decomposition of the fat.

X Q. 198. If, then, in the manufacture of soap from fatty bodies with water and a "carbonated alkali," the degree of heat "should generally be kept between the melting points of tin and bismuth," the degree of heat in the production of "free fat acids" by the action of water should be greater than "between the melting points of tin and bismuth," should it not?

A. It should in the use of the coil apparatus for a continuous and quick action, and no other apparatus for the soap production is mentioned in the English patent.

Examination adjourned to to-morrow (Friday) morning at 9½ o'clock

FRIDAY, *February* 26, 9½ *o'clock a. m.*

Present: B. C. Tilghman, esq., for complainant; Chas. B. Collier, esq., for defendants.

Cross-examination of James C. Booth, resumed:

X Q. 199. Does not the English letters-patent of the complainant state specifically that the degree of heat required for the manufacture of soap is less than that which is necessary to produce free fat acids? Will you answer yes or no?

424 A. Yes: the patent so states it, referring to the coil apparatus.

X Q. 200. Quote the language of the patent referring in that connection to the coil apparatus.

A. It is contained in the patent under the second part of the invention for making soap with fatty matters and carbonated alkali, under which the following are the words, "And for this purpose the apparatus hereinbefore described for producing the fatty acids and glycerine by a continuous process may be used for the production of soap in a similar manner." The contin'ous process is described under the *first* head of the patent, under the following words, on page 3 of the printed copy of English patents. "The process may be performed more rapidly, and also continuo*usly*, by causing the mixture of fatty matter and water to pass through a tube or continuous channel," &c.

X Q. 201. Do you understand that the words, "And for this purpose the apparatus hereinbefore described for producing the fatty acids and glycerine by a continuous process may be used for the production of soap in a similar manner," restrict the operator to the use of the coil apparatus in the manufacture of soap?

ure may be applied, to prevent the conversion of the water into steam," applies to both forms of apparatus or to one only; if to one, which?

A. My view is, that it applies to any vessel whatever in which the essential feature of the patent can be carried out, namely, the decomposition of fat by the action of water at a high temperature and pressure, so as to form free fat acids and glycerine, and if to any vessel therefore to the two named in the patent, as well as to others, and not to any one in particular.

X Q. 189. You understand, therefore, do you not, that, in any form of apparatus in which the complainant's process is practiced, the conversion of the water into steam must be prevented?

A. Practically it must be prevented.

X Q. 190. What do you mean by the word practically?

A. I mean that the vessel should be so filled with the mixture of fat and water, as to allow of the expansion of the mixture on being heated, to avoid the danger of bursting the vessel. In the tube apparatus, the tube should be completely filled to render the process continuous and more perfect.

X Q. 191. Can you refer to and quote any paragraph in the letters-patent of the complainant, indicating that the apparatus,
422 whatever its form may be, should not be closed, and of such strength as that the conversion of water into steam should be prevented; if so, will you make such reference?

A. I know of no paragraph which states that the apparatus should not be closed, and of such strength that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

X Q. 192. What allowance would you make for steam room in the vessel, should you undertake to practice the complainant's process according to his patent?

A. If I were a manufacturer, I could ascertain it by a very simple experiment, by determining the amount of expansion of a mixture of fat and water by heat.

X Q. 193. Would you allow any steam room in the vessel? If so, why would you do so?

A. I would allow so much space above the charge of fat and water as to permit the expansion of the mixture when heated, and for the sake of the expansion.

X Q. 194. You would make no such allowance, would you, in using the coil apparatus?

A. I would not.

X Q. 195. Will you look at the English letters-patent of the complainant now shown you and annexed hereto, marked Defendants' Exhibit, X Ex. Booth 2, and quote the language from said letters-patent, referring to the treatment of fatty matters for *for* the purpose of manufacturing soap, particularly that portion thereof specifying the degree of heat required in conducting such process?

A. The language is as follows: "The degree of heat required is less than that which is necessary to procure free fat acid, and should generally be kept between the melting points of tin and bismuth. At about 340° Far. the neutral fats will form soaps with the solutions of alkaline carbonates, but a higher temperature will produce the result more quickly." This quotation refers to the use of the coil apparatus, as is mentioned in the following words: "The apparatus, before described, for producing the fatty acids and glycerine by a continuous process, may be used for the production of soap in a similar manner," and in the following, "the carbonic acid expelled" "issues from the exit-valve."

X Q. 196. You understood from said English letters-patent, do you not, that a higher degree of heat is required for the production
423 of free fat acid, by the action of water, than is employed in the treatment of fatty matters for the manufacture of soap?

A. The passage quoted refers exclusively to the coil apparatus, in which it is stated that free fat acids may be made from a mixture of fats and water at the temperature of melting lead, say about 600° Far., and that a soap may be made in the same apparatus at about 440° to 500° F., and therefore at a lower temperature.

X Q. 197. Do you think that a change in the form of apparatus would affect the relative degree of heat required for the production of free fat acids by the action of water, and for the manufacture of soap? If so, give your reasons for the conclusions that you may state.

A. In any apparatus suitable for the purposes mentioned in the patent, I believe a lower temperature may be used for making soap than for decomposing into fat acids and glycerine by the action of highly-heated water, because the chemical action of the alkaline matter used to make the soap would facilitate the decomposition of the fat.

X Q. 198. If, then, in the manufacture of soap from fatty bodies with water and a "carbonated alkali," the degree of heat "should generally be kept between the melting points of tin and bismuth," the degree of heat in the production of "free fat acids" by the action of water should be greater than "between the melting points of tin and bismuth," should it not?

A. It should in the use of the coil apparatus for a continuous and quick action, and no other apparatus for the soap production is mentioned in the English patent.

Examination adjourned to to-morrow (Friday) morning at 9½ o'clock

FRIDAY, *February* 26, 9½ *o'clock a. m.*

Present: B. C. Tilghman, esq., for complainant; Chas. B. Collier, esq., for defendants.

Cross-examination of James C. Booth, resumed:

X Q. 199. Does not the English letters-patent of the complainant state specifically that the degree of heat required for the manufacture of soap is less than that which is necessary to produce free fat acids? Will you answer yes or no?

424 A. Yes; the patent so states it, referring to the coil apparatus.

X Q. 200. Quote the language of the patent referring in that connection to the coil apparatus.

A. It is contained in the patent under the second part of the invention for making soap with fatty matters and carbonated alkali, under which the following are the words, "And for this purpose the apparatus hereinbefore described for producing the fatty acids and glycerine by a continuous process may be used for the production of soap in a similar manner." The contin'ous process is described under the first head of the patent, under the following words, on page 3 of the printed copy of English patents. "The process may be performed more rapidly, and also continuously, by causing the mixture of fatty matter and water to pass through a tube or continuous channel," &c.

X Q. 201. Do you understand that the words, "And for this purpose the apparatus hereinbefore described for producing the fatty acids and glycerine by a continuous process may be used for the production of soap in a similar manner," restrict the operator to the use of the coil apparatus in the manufacture of soap?

A. I do not suppose so, because the words "may be used" are contained in the quotations in the questions, and because the coil apparatus is expressly disclaimed as any part of the invention in the patent.

X Q. 202. Does not said patent further state that in the manufacture of soap the heat should generally be kept between the melting-points of tin (440° F.) and bismuth (510° F.)?

A. It does, referring expressly to the coil apparatus, and by such high temperature proposing to gain time in the manufacture; for at the end of the paragraph expressing the degrees of heat named the words are, "A higher temperature will produce the result more quickly."

X Q. 203. Will you state where express reference is made in that connection to the coil apparatus, quoting the language of such express reference?

A. I refer in part to my answer to cross question 200, which connects the continuous process, under the second head of the patent, with the tube or continuous channel for performing the process continuously, under the first head of the patent, and in part to common consent, which has given the name of coil apparatus to the tube or continuous channel, because the drawing shows such tube to be a coil, well-known and named as such in the manufactures connected with fats.

425 X Q. 204. If, as stated by you in answer to cross-question 201, the operator in the manufacture of soap under said patent is not restricted to the use of the coil apparatus, why do you state that the patentee, in stating the degree of heat required for the manufacture of soap to be less than that required in the production of free fat acids, refers expressly to the coil apparatus?

A. The first expression under the second head of the patent states that the manufacture of soap may be made by subjecting the mixture of fat and water and alkali "to high temperature and pressure, in like manner as hereinbefore described in practicing my mode of obtaining fatty acids and glycerine." This clearly refers to the essential feature of the patent, and also to the two kinds of apparatus named, the one being "any convenient vessel," the other "the tube or continuous channel." Immediately following the preceding sentence just quoted, it states that "the apparatus hereinbefore described may be used for the production of soap in a similar manner." The expression of "the degree of heat required is less," is in the middle of the passage describing the continuous process in the coil apparatus, because it refers to the coil apparatus immediately before and immediately after such passage. The reference to coil apparatus previous to the expression, "the degree of heat required is less," has already been shown in previous answers. The reference to the coil apparatus subsequent to that quoted expression, namely, "the carbonic acid expelled from the alkali in the process, when performed in the apparatus above described, escapes as the soap issues from the exit-valve," proves such reference.

X Q. 205. What is the minimum degree of heat stated in said letters-patent at which neutral fats will form soaps with a solution of alkaline carbonates?

A. There is no minimum degree stated. In the use of the coil apparatus 350° F. is named as the lowest temperature at which neutral fats will form soaps with the solution of alkaline carbonates.

X Q. 206. Then you understand, do you not, that in the use of the coil apparatus a higher degree of heat than 350° F. is required by the patent in the production of free fat acids?

A. The patent does not claim the coil apparatus at all, nor does it claim any specific high temperature either for the production of free fat

acids or of soap; but it does state that in the use of the coil apparatus a less degree of heat is required to produce soaps than free fat
426 acids. It does not state that the temperature of 350° is the lowest that will form soaps with alkaline carbonates; but from the expression in the English patent, "a higher temperature will produce the result more quickly," it is evident that the manufacturing gain in time is kept in view.

X Q. 207. In answer to cross-question 205 you say, "In the use of the coil apparatus 350° F. are named as the lowest temperature at which neutral fats will form soaps with the solution of alkaline carbonates." In answer to cross-question 206 you say, "It does not state that the temperature of 350° F. is the lowest that will form soaps with alkaline carbonates." Which of these statements is true; or are they both true?

(Complainant's counsel here objects that the English patent of complainant, having been already put in evidence by defendants, is the best evidence of what it contains.)

A. The answer to cross-question 206 is the correct statement. The part of answer to cross-question 205 quoted in cross-question 207 should read, "is the lowest-named temperature," instead of, "is named as the lowest temperature."

X Q. 208. If it be true as a chemical fact that less heat is required to make soap, as stated in said patent, than to make free fat acids, is not this true whatever may be the form of apparatus employed for the purpose?

A. I have no doubt of the fact.

X Q. 209. If, therefore, in the manufacture of soap, the heat should generally be kept between 440° F. and 510° F., do you, or do you not, understand from said patent that in the manufacture of fat acids according to complainant's process, a greater degree of heat than that above stated is required?

A. As repeatedly stated in previous answers, the temperatures named refer to the coil apparatus; and in such apparatus the manufacture of fat acids is stated to require a greater degree of heat under the similar condition of gain in manufacturing time.

X Q. 210. What fatty body requires the least degree of heat for its decomposition into fat acids and glycerine by the action of water?

A. I leave that question to the experience of manufacturers, inasmuch as the science of chemistry gives no clue to its solution.

X Q. 211. After having given to this branch of science the research and investigation as testified to by you in your examination-in-chief, have you no opinion upon the subject?

A. I have not, never having experimented upon it.

427 X Q. 212. Do you believe that tallow will be decomposed by the action of water at the same degree of heat that will decompose palm-oil?

A. I do not know, not having experimented upon it; nor do I recollect just now which is considered more easy of decomposition by manufacturers.

X Q. 213. Will you quote from the American letters-patent of the complainant the paragraph referring to the change of palm-oil by the action of water?

A. I quote as follows: "But the change of fatty matter into fat acids and glycerine takes place with some materials (such as palm-oil) at or below the melting point of bismuth; yet the heat has been carried considerably above the melting-point of lead without any apparent injury,

and the decomposing action of the water becomes more powerful as the heat is increased."

X Q. 214. Will you now refer to the preceding portion of the paragraph last quoted by you, and state whether you understand from it that the fatty bodies other than "such as palm-oil" require a greater degree of heat for their decomposition than at or below the melting-point of bismuth?

A. In the first sentence of said paragraph the "melting-point of lead' is named as giving good results, and clearly refers to the coil-apparatus and rapidity of operation as applicable to any fat, although "such as palm-oil" may be heated to a lower temperature with the same results.

X Q. 215. What is the lowest temperature in degrees (F.) stated in the American patent at which the change or decomposition takes place in such materials as palm-oil?

A. At or below the melting-point of bismuth, which is about 510° F., still alluding to the use of the coil-apparatus for rapidity of action.

X Q. 216. Will you quote the paragraph from the patent in such connection alluding "to the use of the coil-apparatus for rapidity of action?"

A. The beginning of the third paragraph of the patent states: "The process may be performed more rapidly, and also continuously, by causing the mixture of fatty matter and water to pass through a tube or continuous channel heated to the temperature already mentioned," &c. The melting-point of lead is the point named in the previous paragraph. The fourth paragraph reads as follows: "In the drawing
428 hereunto annexed are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention." The fifth, sixth, seventh, eighth, and ninth paragraphs refer to said drawing, by description and by letters. Then follows the paragraph quoted in answers to cross-questions 214 and 213, which paragraph is an amplification of the description of the proper heat mentioned in paragraph 9. Paragraphs 11, 12, and 13 continue the description of the use of the coil apparatus.

X Q. 217. In the use of the coil apparatus do you understand that the tubes (*d d d d*) through which the fatty mixture is to be passed are to be heated prior to the introduction into them of such mixture?

A. I infer, from the second sentence of the sixth paragraph, that the emulsion of fatty matter and water is driven through the tubes (*d d d d*) previously heated to the temperature of melting lead.

X Q. 218. The patentee contemplates the use of fusible metals in the use of the coil apparatus, does he not, to indicate the temperature of the tubes (*d d d d*)?

A. He uses the three metals, tin, bismuth, and lead, and also nitrate of potash, which fuse at four different points from 440° F. to 660° F., in order to approximate practically to the temperature required in working the coil apparatus.

X Q. 219. What now is your understanding as to the lowest degree of heat contemplated by the patentee in the use of the coil apparatus?

A. With some materials, "such as palm-oil," he contemplates a point "at or below the melting-point of bismuth."

X Q. 220. Do you think that the patent contemplates a lower degree of heat than "at or below the melting-point of bismuth," in the use of any apparatus other than the coil?

A. The claim of the patent, and its characteristic feature, is the de-

composition of fats into fat acids and glycerine by the action of water at a high temperature and pressure, without naming any specific point of temperature.

X Q. 221. In answer to cross-question 219 you have stated that with some materials, such as palm-oil, the patentee contemplates a point "at or below the melting-point of bismuth" as being the lowest heat in the use of the coil apparatus. In the second paragraph of the patent the following language occurs: "I mix the fatty body to be op-
429 erated upon with from a third to a half its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting-point of lead, until the operation is complete." Will you now state whether the words "any convenient vessel" refer to the coil apparatus?

A. They refer to the coil or any other apparatus in which the operation may be performed.

X Q. 222. In the use of a form of apparatus other than the coil, what is the lowest degree of heat contemplated by the patent for the decomposition of fats?

A. No specific point of heat is claimed in the patent, but simply a high temperature and pressure. The specific degrees of heat mentioned refer to the coil apparatus, and to "any convenient vessel" "of great strength" which "may" be used.

X Q. 223. Do you think, then, that all temperatures above 212° F., and all pressures above the pressure of the atmosphere, are contemplated in the patent?

A. The expression "high pressure" is, I think, more generally applied to the pressure of sixty pounds and upwards, corresponding to little above 300° Far. and upwards; but the high pressure mentioned in the patent must be such as will decompose fat into fat acids and glycerine by the action of water heated to the temperature corresponding to such high pressure of the patent. I therefore do not think that all temperatures above 212° F., and corresponding pressures, are contemplated by the patent, unless they have the decomposing action on fats above stated.

X Q. 224. You think, therefore, do you not, that it is left to experiment by the patent to ascertain the lowest degree of temperature and pressure at which fat will be decomposed by the action of water?

A. By no means. (If I wished to perform the operation at the lowest temperature named in the patent, in an ordinary boiler-apparatus, I would bring the mixture of such fat and water in such apparatus at once to somewhat over the temperature of 300° F., when, I know from my own experiments on the subject, I would obtain a decomposistion of fats into fat acids and glycerine by the action of water. The temperature named is what I would term the lowest degree for the expression "high pressure.")

(Counsel for respondents objects to that portion of the preceding answer included in parenthesis as being irresponsive to the question.)

430 X Q. 225. If, as stated by you, it is "by no means" left to experiment by the patent to ascertain the lowest degree of temperature and pressure at which fats will be decomposed by the action of water, will you state what that lowest degree is stated in the patent?

A. The characteristic feature of the patent, in this respect, is a "high pressure," which I have stated to be generally understood as beginning at about sixty pounds pressure, and rising above that. This, therefore, I consider to be the lowest degree stated in the patent.

X Q. 226. What is the temperature corresponding to a pressure of sixty pounds?

A. About 308° F.

X Q. 227. What do you mean by the expression "high pressure is, I think, more generally applied to a pressure of sixty pounds and upwards?"

A. We usually run our mint boilers at a pressure of eighty pounds, which the engineer terms a moderate high pressure. When the pressure is lowered to seventy pounds, he terms it a low high pressure. Although the term "high pressure" is not regarded as a specific point, yet those engineers with whom I have been in contact have thought that the term "high pressure" began at from sixty to seventy pounds. On the boats in the western waters they mostly estimate their high pressures at from one hundred to one hundred and sixty pounds pressure. I have made the fusible plugs for the high-pressure steamers, subject to Government inspection, from the year 1854 to the present time. The lowest high-pressure which has ever been ordered from me by the inspector was ninety pounds pressure.

X Q. 228. Your interpretation, then, of the language of the claim in the American letters-patent of the complainant, wherein the words "high temperature and pressure" are employed, is governed by the facts mentioned by you in your last answer, is it not, rather than by the specification of the complainant's patent?

(Objected to by complainant's counsel on the ground that it is not within the province of an expert to make an interpretation of the claim of the patent.)

A. It is governed partly by such facts and partly by the last clause of the second section of the second paragraph. I quote the whole sentence: "I subject these fatty or oily bodies to the action of water
431 at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine."

X Q. 229. Will you now state whether there is a minimum of high pressure and temperature stated in the patent, at which the elements of fatty bodies will combine with water, so as to produce free fat acid and glycerine? If there is a minimum mentioned, state what it is.

A. There is no lowest specific amount given in the patent for such combination of fatty bodies.

X Q. 230. Is any minimum mentioned in general terms in the patent?

A. There is none.

X Q. 231. There is no indication, is there, in the patent, of such minimum high pressure and temperature?

A. There is a clear indication that high pressure is requisite, the minimum of which I would understand to be about sixty pounds pressure.

Examination adjourned to 2½ o'clock p. m. of this day.

FRIDAY, 2½ *p. m.*

Present: Benj. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

Cross-examination of witness resumed:

X Q. 232. Will you quote the words, line by line and paragraph by paragraph, in the patent from which you derive such understanding?

A. I have stated in previous answers that I understand the lowest point of "high pressure" to be about sixty pounds, and that it rises

from this to an indefinite amount beyond. My understanding of the word "high pressure," as used in the patent, has its lowest limit, therefore, in this idea of sixty pounds, which is not at all expressed in the patent, and is merely an expression of my own experience.

X Q. 233. Do you not know that "at or below the melting-point of bismuth" is the minimum high temperature mentioned in the patent at which the elements of fatty bodies will combine with water; and do you not also know that such minimum is mentioned in connection with those fatty bodies the elements of which most readily combine with water, such as palm-oil?

A. I find that the melting-point of bismuth is the lowest point named by the patentee for conducting the process in the coil
432 apparatus upon fats such as palm-oil; but that this point of temperature is not designed to express the lowest possible point of decomposition of fats by water I would infer from the claim of the patent to the simple term of "high pressure," and to the permissive use expressed by the word "may" of "any convenient vessel," or of the coil apparatus, since the specific points of temperature named only refer to the two kinds of apparatus mentioned. I infer that the term "high pressure" refers to any pressure that would be designated as high pressure in the arts which would decompose fats by the action of water.

X Q. 234. Will you now state the pounds of pressure corresponding to such minimum temperature in the use of the "coil apparatus?"

A. The melting-point of bismuth, taken at 510° F., corresponds to 735 pounds pressure.

X Q. 235. Will you now state the difference between this minimum pressure in the coil apparatus of the complainant and the maximum pressure employed in the process of the defendants, as described in their answers?

A. 650 to 660 pounds is the difference.

X Q. 236. What is the consistence of a neutral lime-soap? Is it soft or solid?

A. When pure it is a pulverizable solid.

X Q. 237. In the process of saponification upon the formation of lime-soap, does it become immediately solid?

A. Being mixed with oleates and glycerine it presents itself, in its impure state, as of a buttery consistence; but when purified it is a pulverizable solid, hard as compared with washing soaps, but soft as compared with ordinary hard substances.

X Q. 238. What action or effect, if any, has water at high heat and under pressure upon a lime-soap?

A. I have never tried the experiment, but would infer on chemical grounds that water would not decompose a lime-soap.

X Q. 239. Would the chemical relation existing between the lime and fat acid in a lime-soap be at all disturbed by the action of water at high heat, say 510 F., and under pressure with agitation?

A. I should say it would not on general principles; but nevertheless I would not affirm it without experiment, which I have not made, to test the point.

X Q. 240. In the process of lime saponification, with a full equivalent of lime, and not under pressure, does the lime-soap, immedi-
433 ately after the chemical combination takes place, settle to the bottom of the digester or tank in which the operation is performed?

A. In the operations of lime saponifications performed by myself in

a small way, there was a segregation of lime-soap which settled to the bottom and was caused to rise by the act of ebullition, so that a continued circulation is maintained. I have not witnessed the operation performed on a manufacturing scale.

X Q. 241. In the process of lime saponification in a closed vessel, with water at a high heat and pressure, would the lime-soap, immediately after its formation, settled to the bottom, a full equivalent of lime being used?

A. I have not seen the interior of a vessel under the conditions named, but infer from samples drawn from the same that the lime-soap, as fast as formed, is caught and held by the still unaltered fat, and even towards the last of the complete saponification samples drawn show a mixture of lime-soap and unaltered fat.

From these facts I infer that there is no great amount of segregation of the lime-soap; and I infer the same from the greater rapidity of the saponification when agitation is used, because such agitation disengages the materials from each other's embrace, allowing the more free chemical action of the lime upon the fat. After all the fat has combined with all the lime, the finished lime-soap will subside, if there be liquid enough for it to subside in.

X Q. 242. In the process of saponification, or decomposition of fats, by the action of water at high heat and pressure, with less than a full equivalent of lime, does such subsidence of the lime-soap as formed take place as stated in your last answer?

A. If the proportion of lime were very small, I infer that no segregation of the lime-soap would take place. If the proportion of lime were large as compared to the fat, final segregation would be likely to occur, but I cannot state at what particular proportion between lime and fat more or less segregation would take place.

X Q. 243. Would the concurrent action of superheated steam and water, at high pressure, tend to prevent such segregation or subsidence of the lime-soap, such superheated steam being constantly forced into the bottom of the vessel in which the operation is conducted, such as in defendants' digester, described in their original answers?

A. No segregation of lime-soap takes place in defendants' process, as I infer from my analysis of their products, which in one case was a
434 complete mixture of lime-soap and unaltered fat; in another, lime-soap, unaltered fat, and free fat acid, and, in a third, a mixture of lime-soap and free fat acid. The answer of defendants shows that no segregation takes place, because only two products are mentioned, to wit, "the watery product and the other product, their so-called "acid lime-soap," which I proved to be a mechanical mixture of neutral lime-soap and free fat acid.

X Q. 244. You have stated, have you not, in your examination-in-chief, that in the process of decomposition of fats as practiced by the defendants, the action of the water upon the fat to produce free fat acid does not commence until after the lime has combined with its equivalent of fat acid?

A. I have so stated.

X Q. 245. Have you read the deposition of N. Ropes, given by him in the former suit of the complainant herein, against the defendant, M. Werk, already alluded to by you in your examination-in-chief; and if so, do you understand the process practiced by him, as described in answer to question 4 of said deposition, found on page 110 of printed copy, now exhibited to you?

A. I have read and understand it.

X Q. 246. In said answer of said Ropes the following language occurs: "The time for cooking depends measurably upon the quantity of lime used in connection with the water. With no lime a good stock, well crystallized, has been produced in twenty hours. With one-half per cent. of lime it usually takes about six hours, and probably it could be done in a shorter time with from one to two per cent. of lime." Upon the hypothesis that the statement so quoted is true, how do you account for the celerity with which decomposition is effected in the presence of lime, as compared with its decomposition without the use of lime?

A. I account for it theoretically on two grounds: First, that a small quantity of impurity, usually accompanying the fats of commerce, and which probably prevents the immediate action of the water, combines with some of the lime, is rendered inert and innocent, leaving the water more freedom to act; and, second, that lime, on account of its alkaline power, commences the decomposition of the fat, which is then continued by water. This last depends upon a principle very generally admitted in chemistry, that it is more difficult to commence a decomposition than to continue it, and that when once begun it goes on more rapidly. I draw these inferences also from the statement of Mr. Ropes in the place cited, that with a half per cent. of lime it will take about six
435 hours to complete the decomposition, as compared with the statement of defendants in their original answer, that, with as much as seven per cent. lime, still six hours were also required for the decomposition.

X Q. 247. Taking the first theory advanced by you in your last answer, will you state the character of the "small quantity of impurity usually accompanying the fats of commerce, which probably prevent the immediate action of the water?"

A. Gelatinous and membraneous residues, and some acids formed by oxydation of these bodies, and probably oxydation of a little fat, constituting odorous products, to which, in part, the name rancidity is given.

Examination adjourned to to-morrow (Saturday) morning, at 9½ oclock.

SATURDAY, *Feb.* 27—9½ *a. m.*

Present: B. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

Cross-examination of James C. Booth resumed:

X Q. 248. Does not rancidity imply a partial decomposition of the fat?

A. Not necessarily. It applies rather to the oxydation of the impurities associated with fat, and also, doubtless, to the oily associates with the more solid fats. The most solid portions of fat are very little liable to oxydation under ordinary conditions.

X Q. 249. What is implied by the oxydation of fats and oils?

A. The union of oxygen, especially with the oily fats, whereby new products are generated, which have been examined chemically to a very limited extent, and found to exhibit acid properties, to be more or less volatile and odorous, and these acids, or a portion of them, combined with glycerine, either oxydized or unoxydized, forming new compounds. But the subject has not been so precisely and fully investigated as that much more definite information can be given on the subject.

X Q. 250. Is not this a decomposition?

A. It is certainly a decomposition by oxydation, which is one kind of decomposition.

X Q. 251. Understanding you to have said that such oxydation or decomposition interferes with or arrests the action of water at high heat and under pressure upon fatty bodies, will you give your reasons for so stating?

A. I stated, in answer to X Q. 246, that it was my theoretical view that such was the probable action of lime, giving it as one of
436 the reasons for an observed fact that a small quantity of lime hastens the decomposition of fats by water at a high temperature and pressure. I did not assert that it arrested the action of highly heated water. At the conclusion of said answer I showed, from the testimony of Ropes compared with defendants' original answer, that the addition of fourteen times as much lime as was used by Ropes did not shorten the time of decomposition of fats by highly-heated water; and hence the inference appeared to me clear that the small quantity of lime acted in part by removing the impurities by combining with and rendering them inert, leaving the highly-heated water more free to act.

X Q. 252. Was not the inference so drawn by you concluded upon without taking into consideration the fact that Ropes worked with a pressure of about 150 pounds to the square inch, with his one-half per cent. of lime, while the defendants used about seventy-five pounds, with their seven per cent. lime?

A. It was drawn with a full knowledge of that fact, and based also upon repeated experiments made by myself on the decomposition of fats by highly heated water, with and without a small quantity of lime, at temperatures varying from 320° F. to over 600° F., and I thought that the difference between seventy-five pounds pressure and one hundred and fifty, being a difference of only forty degrees of heat, was not sufficient to account for the equality in the length of time, namely, six hours, when a half per cent. and seven per cent., respectively, are used.

X Q. 253. In one hundred pounds of commercial fat such as used by candle-manufacturers, what percentage of the "impurities" referred to by you would exist?

A. I have never determined the amount nor the kind of impurity, nor do I recollect the statement of the amount made in books; but have only heard from manufacturers that it amounted from nothing to several per cent., the statement of percentage made by different individuals being very different.

X Q. 254. State who has mentioned to you the existence of several per cent. of such impurities.

A. I really cannot recollect the individual. I now remember Mr. Campbell Morfitt was one.

X Q. 255. Is the existence of such impurities mentioned by Mr. Morfitt in either of his treatises on "Chemistry applied to the Manufacture of Soap and Candles," which have been produced by you in this case, and are now before you? If so, will you quote the paragraphs referring to such impurities?

437 A. In chapter 24 of second edition, 1856, are various processes described for purifying the raw material for candles. At page 327, said edition, are the words: "The inferior quality and color of much of the rendered suet, as found in commerce, creates a necessity of a preliminary treatment for purifying and raising it to the proper condition of candle stock."

X Q 256. Do you mean to testify that the existence of the impurities to which you have referred delays the action of highly heated water upon neutral fatty bodies?

A. That is my theory. I have stated it as such.

X Q. 257. Passing to the second theory advanced by you in answer to X Q. 246, you say, "Second, that lime, on account of its alkaline power, commences the decomposition of the fat, which is then continued by water." Will you please make this answer more explicit.

A. Lime is universally acknowledged by chemists to be a strong base, having great power of uniting with acids to form salts; so much so that when heated with organic bodies it will always take an acid out of those bodies if they be capable of forming an acid. In this, its so-called alkaline or basic character, it is the chemical opposite of an acid. Water is regarded by chemists both as a feeble acid and a feeble base, so that it will unite with an acid as a base, and will unite with a base acting the part of an acid. Lime being, then, a strong base and water a feeble one, I would infer, on chemical grounds alone, that the lime would first satisfy itself with all the acid it could get out of a fat before the feeble base or acid (water) can begin to act.

X Q. 258. What portion of the fat does the lime, "on account of its alkaline power," begin to decompose?

A. Apart from the neutralization of any free acids present, which it would first lay hold of and combine with, any residue of lime would then act upon the fat as a whole, and abstract sufficient acid to satisfy its atomic power.

X Q. 259. The influence of the lime upon the whole body of fat would cease, would it, when the lime had extracted therefrom its equivalent of acid?

A. It would then cease.

X Q. 260. And the lime would continue to influence or affect the whole mass of fat until it had satisfied itself with fat acid?

A. Every atom of free lime would act upon every adjacent atom of fat until the lime was satisfied.

438 X Q. 261. And this it would do conjointly with the water present, would it not?

A. It would do so with just so much water as would be necessary to form glycerine from the elements of glycerine contained in that portion of the fat from which the lime had abstracted the acids.

X Q. 262. The lime would not act at all, would it, except in connection with the water?

A. It could not act without water to form lime-soap on one side and glycerine on the other; but it might act to form a salt of lime with an acid abstracted from the fat without water, in which last case the glycerine would be destroyed. It is probable, however, that this last process would either not form a true lime-soap, or it would do so with the destruction of a portion of the fat acid, and could not, therefore, be an economical manufacturing process.

X Q. 263. Is it your opinion, as the result of your experiments and research in this branch of science, that fats can be decomposed into free fat acids and solution of glycerine by the action of steam?

A. Steam, when passed through melted fat at such a temperature that liquid water cannot exist, will decompose the fat, eliminating fat acid mostly uninjured, and will decompose the glycerine more or less, so as to form acroleine, and probably other products. This I have proved by direct experiment. When steam is passed through melted fat in the presence of liquid water, and at high pressure, say 300° temperature and upwards, the fat will then be decomposed into free fat acids and a solution of glycerine; but in this case the steam only acts as a source of heat, as I have also proved by direct experiment, in which fat and water were heated to a temperature of over 300° by direct heat, without the

use of steam. I know of no case by research, prior to the date of plaintiff's patent, in which fats were decomposed into fat acids and solution of glycerine by the action of steam. I therefore know of no such case, either by my own experiment or by research.

X Q. 264. Is it your opinion, as the result of your experiments and research in this branch of science, that fats can be decomposed into free fat acids and the solution of glycerine by the action of steam, without reference to the date of complainant's patent?

A. I have not made an experiment with that object in view, and can therefore form no opinion from experiment. I would, however,
439 infer from reading Wilson & Paine's English patent of July 24th, 1854, No. 1624, that fats may be decomposed into fat acids and glycerine by distilling them with superheated steam at a temperature between 550° and 600° Far.

X Q. 265. Is that the lowest temperature at which, in your opinion, fats will be decomposed into free fat acid and solution of glycerine by the action of steam?

A. I know of no lower temperature than that stated in my last answer at which such decomposition would take place, except in the presence of liquid water, and in that case, as stated in answer to X Q. 263, the decomposition is effected by liquid water, steam being merely the source of heat.

X Q. 266. Does your last answer refer to such decomposition by steam in a closed or open vessel?

A. The apparatus being a still and receiver, in which the temperature mentioned in answer to X Q. 264 is specified, it is an open vessel as relates to pressure.

X Q. 267. Then superheated steam may exist in a vessel not under pressure, do you mean to state?

A. I do.

X Q. 268. Then water in a liquid form in an open vessel may exist at a temperature of from 550° to 600° Far.?

A. It cannot so exist as liquid water.

X Q. 269. Was, therefore, in the apparatus referred to by you in answer to X Q. 264, in which you state that fats may be decomposed into fat acid and glycerine, liquid water present?

A. It could not have been present, because the still itself was heated by open fire to a temperature below 550° F., and a current of steam passed through at between 550° and 600° F., and it is expressly stated in the patent that the products are carried across into the receiver by a current of steam, which current, being superheated, would take up any liquid water present.

X Q. 270. As the result of your experiments and research in this branch of science, are you able to state whether or not fatty bodies can be decomposed by the action of superheated steam in the absence of water, at a lower temperature than 550° to 600° F.?

A. As the result of my experiments, I can only state that fat can be decomposed by steam, superheated to about the melting-point of lead. As the result of research I find that Scharling states that he decomposed fat by the vapor of water at 320° F.

Examination adjourned to Tuesday morning next, (March 2d,) at 9½ o'clock.

440 TUESDAY, *March 2d*, 9½ *a. m.*

Present: B. C. Tilghman, esq., for complainant; Charles B. Collier, esq., for defendants.

Cross-examination of James C. Booth resumed:

X Q. 271. Do you mean now and by your last answer to retract your answer to X Q. 265, in which you say that you know of no lower temperature than 550° to 600° F., at which fats may be decomposed into fat acids and glycerine by the action of superheated steam, or do you adhere to the answer then given?

A. When I gave my answer to X Q. 265, my mind being drawn specially to the decomposition by distillation as described in Wilson's patent, the process of Scharling alluded to in my last answer did not then occur to me. In Scharling's process decomposition takes place, according to his statement, by steam superheated, accompanied with distillation, at 320° Far., the fat acid passing over, and no allusion made to glycerine. (Moreover, the fat named is palm-oil, and he, Scharling, states that tallow could not economically be decomposed in this manner. In Wilson's process, referred to in answer to X Q. 264 and 265, both the fat acid and glycerine are alleged to be produced. In Scharling's process only fat acid is alleged to be produced. But in neither process is fat decomposed into fat acid and glycerine by the action of highly heated water.)

(That portion of the answer within parenthesis objected to by defendants' counsel as not being responsive to the question.)

X Q. 272. X Q. 271 repeated.

(Complainant's counsel objects that the X Q. 271 does not correctly quote X Q. 265, to which it refers, in this, that X Q. 265 says "solution of glycerine," while X Q. 271 says "glycerine.")

A. The greater part of knowledge is due to memory, and as memory does not act always instantaneously, hence the superior advantage in the deliberate writing of answers to questions propounded over answers dictated by word of mouth. From the framing of the previous questions my mind was specially drawn to the decomposition of fat by the action of superheated steam, and when the X questions 264 and 265 were propounded I did not at the moment recollect the process of Scharling, which decomposed palm-oil at a lower temperature than 550°,
441 so that in relation to the mere decomposition of fat, without relation to glycerine, a lower temperature than 550°, if Scharling's statement be true, should be given as one at which a fat will decompose. In my answer to X Q. 264 I meant solution of glycerine instead of glycerine, which (solution of glycerine) was referred to in the question. So far, then, as relates to the decomposition of fat by superheated steam, so as to obtain both free fat acids and solution of glycerine, I do not retract so much of the answers to X Q. 264 and X Q. 265 as states the lowest heat known to me to be 550° Far.

X Q. 273. Is Wilson & Paine's process one of distillation?

A. It is.

X Q. 274. Do you mean that by it solution of glycerine is obtained?

A. I quote the following from Wilson & Paine's patent: "Our invention" * * * "consists of distilling over glycerine, together with fat acids, from" * * * "fats, the glycerine and fat acids being mixed, but uncombined, so they will separate when allowed to stand, by which process" * * * "the glycerine" * * * "will be dissolved in the water resulting from the condensation of steam." A solution of glycerine is therefore obtained.

X Q. 275. If, therefore, glycerine is "distilled over," it is found as the solution of glycerine, is it not?

A. It is.

X Q. 276. I ask you now if you have not long known that superheated steam, in the absence of liquid water, and at a temperature far below 550° F., will decompose fats into fat acids and solution of glycerine; and have you not testified to that fact in your examination-in-chief herein, and have you not also repeatedly testified to it in other suits than this? and you are referred now to answer 91 of your examination-in-chief.

A. I have only known such decomposition into fat acids and solution of glycerine since reading Wilson & Paine's patent, and I am not aware of having testified to that effect in suits prior to the present one. I speak from memory. The answer to question 91 refers to Wilson's patent, and also to Berthelot's experiments, which were first known to me at the same time that Wilson & Paine's patent was made known to me. Wilson's patent and Berthelot's experiments refer to distillations of solutions of glycerine. Wilson & Paine's patent describes the decomposition of fat by distillation with superheated steam, with the production of free fat acid and solution of glycerine.

442 X Q. 277. Have you read the deposition of Professor Robert E. Rogers, given on behalf of the complainant in the suit against Mitchell, heretofore referred to, commencing on page 82 of printed copy?

A. I have read and I understand it.

X Q. 278. When did you read it?

A. Several years since.

X Q. 279. In answer to question 29, page 89, of said deposition Professor Rogers says: "In consequence of the names Du Brunfaut and Scharling having been associated in questions and answers which I have heard to-day, I find I have represented the results to be expected in Du Brunfaut's experiments as those belonging to Scharling, while, in fact, since Scharling's experiments were made at only 320° F., the decomposition of glycerine and the production of acroleine would not take place." Do you agree with Professor Rogers in the opinion expressed by him, that "the decomposition of glycerine and the production of acroleine would not take place" in Scharling's process?

A. I infer that it would not take place at the temperature of 320° F., as in Scharling's experiments, basing my opinion upon the statements in Wilson & Paine's patent, that glycerine is not decomposed by superheated steam at 550° F.

X Q. 280. If, therefore, as stated by you in answer to X Q. 270, you find that Scharling states that he decomposed fat by the vapor of water at 320° F., and if by such decomposition the glycerine of such fat was not destroyed, then Scharling did produce free fat acids and solution of glycerine, did he not?

A. I infer from Wilson & Paine's patent that Scharling, by superheated steam at a temperature of 320 F., did decompose palm-oil into free fat acid and glycerine; but as he does not mention glycerine as a product, either he did not obtain it, or he had not the wit to take advantage of the discovery if he did obtain it.

X Q. 281. If, therefore, as stated in your answer to X Q. 265, that you "know of no lower temperature than that stated in last answer, (to wit, 550° to 600° F.,) at which decomposition into fat acid and glycerine can be effected by superheated steam, except in the presence of liquid water, and that in that case the decomposition is effected by liquid water, steam being merely the source of heat," then liquid water was present in Scharling's process, was it not?

A. What I state as knowing refers to positive knowledge de-
443 rived from experiment or research, and not from inferences

upon the past facts described from subsequent knowledge. I infer from Scharling's description of the process that it was a distillation at the temperature of 320° F., that liquid water could not have been present in a distillation at that temperature. Liquid water could not be present in a distillation at that temperature.

X Q. 282. Scharling used a covered vessel, did he not?

A. He did, as all stills must be.

X Q. 283. Do you mean to testify that there was no condensation of steam in the "boiler" used by Scharling?

A. I do, because it is expressly stated that the boiler was heated by a coal fire to the temperature of 320° F., at which point steam could not condense into liquid water without being under pressure.

X Q. 284. Do you mean to say that the palm-oil, when placed in said boiler, was at a temperature of 320° F.?

A. The palm-oil was brought to that temperature by means of superheated steam.

X Q. 285. The superheated steam, in bringing the palm-oil to such temperature, must itself have been condensed into water, must it not, until an equilibrium of temperature between steam and oil had been obtained?

A. If he began the operation when the material and boiler were below 212° F., steam must have condensed into liquid water, which would be again resolved into steam as the temperature arose above 212° F. He makes no mention of the commencing temperature.

X Q. 286. In the defendants' apparatus is not superheated steam in large quantity continually present and operative during the process?

A. It is stated to be driven in during the operation, and must therefore be continually present. The mode of its operation is minutely detailed in answer to Q. 19.

X Q. 287. In the decomposition of fatty bodies into free fat acid and solution of glycerine by the action of superheated steam in such form of apparatus as described by Scharling, will you please state the precise chemical operations, as they successively take place?

(Complainant's counsel objects that Scharling does not state the decomposition of fatty bodies into free fat acids and solution of glycerine by superheated steam.)

A. It appears from Scharling's description of the process that
444 he obtained from two pounds of fresh palm-oil, in two hours' time, one pound of fat acid, and that he did not examine any other product. I infer from knowledge subsequently gained that the heat employed must have decomposed a portion of the fat into free fat acids and glycerine, but that he was entirely ignorant of the production of glycerine, or else he would have availed himself of the process for profit, if he had known that glycerine had been so produced.

X Q. 288. In the palm-oil and other fatty bodies treated by Scharling, and before their treatment, glycerine existed as the base of such fats, did it not?

A. I have no doubt of it.

X Q. 289. When such fats, so treated by him, were resolved into free fat acids, what was substituted for said base "glycerine?"

A. No mention is made by him of any substitution, and, as stated in previous answer, I infer that glycerine was produced, although he appeared to have been ignorant of it. I know of no substitution for glycerine.

X Q. 290. The glycerine of said fats must have been freed from its

chemical combination with the fat before free fat acids were produced, must it not?

A. The elements of glycerine are simultaneously produced with the elements of fat acids on their separation from each other, both assuming the elements of water in order to become respectively free fat acids and glycerine. Now, as he states that free fat acids were produced, the elements of the glycerine must have separated at the same time, but he does not state whether glycerine was produced or resolved into other bodies. He does state that acroleine, one of the products of altered glycerine, was not obtained. It is merely my inference from subsequent knowledge that glycerine was obtained.

X Q. 291. Then is Scharling's process the elements of the fat acids in such fats combined with the elements of water to form free fat acids, did *it* not?

A. I have no doubt that they did.

X Q. 292. And they took such elements of water from the steam with which they were heated, did they not?

A. I have no doubt of it.

X Q. 293. And if glycerine, in said process, was formed simultaneously with the formation of the fat acids, then the elements of glycerine existing in such fats combined with the elements of water to form solution of glycerine, did it not?

445 A. If it were formed, it undoubtedly was formed in the way stated in the question. I infer it to have been formed, though Scharling makes no mention of it.

X Q. 294. Will you now state the precise difference, if any, in the chemical principles and affinities involved in such decomposition of fats into free fat acids and solution of glycerine, by the action of highly heated steam on the one hand, and highly heated water on the other?

A. If free fat acids and glycerine be formed in either case, the chemical principles involved, to wit, the assumption of the elements of water in order to form free fat acids and glycerine, are the same. (The manner of performing the operation is different.)

(The last sentence of answer objected to as being irresponsive to the question, and the question repeated.)

X Q. 295. X Q. 294 repeated.

A. If free fat acids and solution of glycerine be formed in either case, the chemical principles and affinities involved, to wit, the assumption of the elements of water in order to form free fat acids and solution of glycerine, are the same in both.

X Q. 296. If the free fat acids and solution of glycerine be produced by the action of superheated steam in a distillatory apparatus or open vessel on the one hand, and by the action of highly-heated water on the other, the chemical principles involved are the same, are they not; and the only difference between the two processes consists in the form of the apparatus, does it not?

A. The chemical principles involved in the two processes are the same, and the difference between the processes is that, in the one case, the decomposition is effected by highly-heated water, and in the other by steam. The apparatus, in the one, is closed and under pressure, in the other it is open and not under pressure. The chemical principles involved are the same as to the formation of free fat acids and glycerine. The one is a process of distillation, to wit, the process by steam; the other is not a distillation.

X Q. 297. If, as a chemist, you are informed that fats are decom-

posed by any process into free fat acids, without the slightest trace of acroleine compounds being remarked or observed, would you infer that solution of glycerine was obtained, or that glycerine was destroyed; which?

A. My first inference would be, if the temperature had not been too high, that glycerine, or, if sufficient water were present, solution of glycerine, had been formed; but it would not necessarily follow,
446 because glycerine is a body quite sensitive to decomposition, forming other bodies besides acroleine.

X Q. 298. I quote now, from Scharling, Defendants' Exhibit No. 12: "In all these distillations there was not the slightest trace of acroleine compounds remarked, (observed,) and I have found no more pyroleic acid or sebacic acid in the water distilled over." What do you infer from that statement as to the production of solution of glycerine from such processes of Scharling?

A. I would infer that glycerine was produced, and would be confirmed in this inference by knowledge gained from Wilson & Paine's patent.

But because other substances besides acroleine compounds have been produced, the inference would not be absolutely true, but should be tested by experiment.

X Q. 299. You have stated in A. to X Q. 294, repeated, as follows: "If free fat acids and solution of glycerine be formed in either case, (that is, by highly-heated steam on the one hand, and highly-heated water on the other,) the chemical principles and affinities involved, namely, the assumption of the elements of water to form free fat acid and solution of glycerine, are the same in both." You have further stated, in answer to X questions 291 and 293, that you infer that free fat acids and solution of glycerine were formed in Scharling's process by combining with the elements of water. Will you now state, leaving out of view the difference in the forms of apparatus employed by Scharling and Tilghman, respectively, what new chemical principle, if any, was discovered by Mr. Tilghman and is made known in his said letters-patent?

A. I have stated in several answers, both those referred to in the question and others, that the chemical principles involved in the formation of fat acids and glycerine are the same in the several processes referred to, but I have nowhere stated that the chemical principles and affinities involved in the decomposition of the fat into free fat acid and glycerine are the same in Scharling's and Tilghman's process. I will now state, as a more general fact, that it has been known for over thirty years that when fats are decomposed so as to form free fat acids and glycerine, either directly or indirectly, the elements of water are taken up by the elements of the fat acids and of the glycerine so as to form, when separated from each other, free fat acids and glycerine. There is therefore nothing new in these chemical principles and affinities. Until the
447 date of Mr. Tilghman's patent I cannot find that it was known to any one that neutral fats could be decomposed into free fat acids and glycerine by the action of highly-heated water. This chemical principle, then, namely, the decomposition of neutral fats into free fat acids and glycerine by the action of highly-heated water, I regard as a new chemical principle discovered by Mr. Tilghman, and different from the chemical principles involved in any other process known.

X Q. 300. Have you not stated that you believed or inferred that Scharling decomposed fats, producing free fat acids and solution of

glycerine by the action of superheated steam, and do you not now so state and believe?

A. I did so infer, and do now infer and believe it.

X Q. 301. Have you not stated, and do you not now state and believe, that in Scharling's process such free fat acids and solution of glycerine were formed by the elements of those fat acids and of glycerine existing in the fats, combining with the elements of water?

A. I have not so stated, but I said that I inferred and believed it, in answer to the questions if solution of glycerine and free fat acids were formed; and I now re-assert that in as far as such free fat acids and glycerine were produced, as far as the production was concerned, the operation was as stated in the latter part of the question.

X Q. 302. Supposing then that Scharling did produce free fat acids and solution of glycerine, and leaving out of view the difference, if any, between the apparatus employed by him and that employed by Mr. Tilghman, will you now state what new chemical principle in the decomposition of fats was discovered by Mr. Tilghman?

A. Mr. Tilghman discovered that neutral fats could be decomposed into free fat acids and solution of glycerine by the action of water at a high temperature and pressure. This I regard as a new chemical principle.

X Q. 303. In Mr. Tilghman's process do not the elements of fats take up the elements of water on the one hand to form free fat acid, and do not the elements of glycerine on the other take up the elements of water to form solution of glycerine?

A. They do.

X Q. 304. Do they not do this also in Scharling's process?

A. I infer that they form free fat acids and glycerine, which last forms a solution of glycerine by condensation of steam in the receiver.

448 X Q. 305. When did you first hear of the use of liquid water at a temperature such as employed by Mr. Tilghman?

A. I first heard of it about 1832 or 1833, when I witnessed the operation of the so-called Perkins steam-gun.

X Q. 306. In your deposition, given in the original suit against the defendant, Werk, you testified as follows, did you not? "The use of superheated steam has been known for many years—for twenty years—for manufacturing purposes. I have not heard of water being used at such a temperature until I heard of Tilghman's patent. I have known steam to be used at 2,000 atmospheres—supposed to be 2,000—in Perkins' steam-gun."

A. I did so testify.

X Q. 307. Perkins' steam-gun was not the same as Perkins' steam-engine, was it, referred to in Defendants' Exhibits 1, 2, 3, and 19?

A. It was not.

X Q. 308. Was not the announcement first publicly made by Mr. Perkins in connection with his said steam-engine, that water could be heated under pressure to such high temperature without passing into vapor, so far as your knowledge extends?

A. I am not at all aware of such an assertion by Mr. Perkins being claimed as the first announcement of that fact.

X Q. 309. Can you refer to an earlier announcement of it?

A. I cannot, at this moment, recollect a date of such announcement, but know that it was long anterior to Mr. Perkins' time.

X Q. 310. In Defendants' Exhibits Nos. 1, 2, and 3 it is announced, is it not, that fat was changed by water, heat, and pressure?

A. It is announced in the title of Exhibit' 1, 2, and in the first clause of No. 3.

X Q. 311. Do you know what the pressure was in the generator of Mr. Perkins' steam-engine?

(Complainant's counsel objects to the question as being vague, and that it does not specify what generator or engine is referred to, or in what Exhibit.)

A. It is nowhere stated in the Exhibits 1, 2, 3, or 19. After stating, in Exhibit 19, that he believed water could be heated to a force equal to 56,000 pounds to the inch without boiling, he further states that it was not necessary to heat the water to more than 500° F. to have it flash into steam. In describing the details of his engine it is stated that a valve, S, is loaded with a weight equal to 700 pounds on
449 the square inch, which is nearly fifty atmospheres. These are the only expressions of pressure which I find in the Exhibits in reference to Perkins' steam-engine.

X Q. 312. Taking Exhibit No. 1, what became of the steam which passed from the generator into the cylinder of the engine?

A. It was condensed into water subsequently to performing its functions in the cylinder, issuing as water from the end of the ejection-pipe into the tub placed to receive it.

X Q. 313. Was not the cylinder a closed vessel so far as pressure was concerned?

A. It was.

X Q. 314. Was not the steam which passed into it from the generator condensed there to some extent?

A. I infer that it was not from the description given in Exhibit 19, in which it states that when the steam drove the piston, such action "opened a pipe, K, into which the steam passes," and in which it is condensed.

X Q. 315. Do you think it possible that no condensation took place in the cylinder?

A. I cannot judge of a possibility when we have the direct expression that the steam passed through the pipe K.

X Q. 316. What became of the condensed steam?

A. It entered as water into a tub placed to receive it.

X Q. 317. What then became of it?

A. It was repumped into the generator.

X Q. 318. The change that took place in this fat, then, whether caused by the steam or by the water, took place in a closed vessel and at high temperature and pressure, did it not?

A. It appears to have done so.

X Q. 319. Will you look at page 172, referred to in Defendants' Exhibit No. 2, and state under what subject-matter such change of fat in Perkins' engine is referred to?

A. Under head of "Miscellaneous Intelligence" in "Chemical Science."

X Q. 320. Is it not stated in Exhibits 1 and 2 that the fat so changed in Perkins' engine "dissolved readily in alkalies?"

A. It is so stated.

X Q. 321. Does a neutral fat "dissolve readily in alkalies?"

A. Not very readily, unless the alkali be very strong.

X Q. 322. Do not Exhibits 1 and 2 state that this fat, as changed, resembled Chevreul's acid of fat, inasmuch "as it dissolves readily in alkalies," "as well as in its solubility in alcohol?"

450 A. No; the experimenter thinks that it is more readily soluble

in alkalies than fat, and in this respect, as well as in its solubility in alcohol, resembles Chevreul's acid of fat.

X Q. 323. From your knowledge, derived from experiment and research in this branch of science, are you of opinion that the fat used in Perkins' engine and exposed to the action of steam or water, or both, as this fat was exposed, was not decomposed?

A. I would not have known at that period whether it was decomposed by water, steam, or heat of either; but now, in the light of Mr. Tilghman's patent, I would suppose that it was decomposed.

X Q. 324. And if decomposed, then it resembled Chevreul's acid of fat, did it not?

A. According to the experiments made upon it, it resembled that acid in some respects, and in others it did not.

X Q. 325. In view of your present knowledge, you believe, then, do you not, that this fat in Perkins' engine was decomposed, producing fat acid in a close vessel at high temperature and pressure?

A. I infer that it might *to* have done so, but the experiments then made upon it do not at all clearly allow of such a conclusion. Its nearly insolubility in ether, and its leaving an ash principally of carbonate of lime, together with its black, dirty, waxy appearance, and not melting in boiling water, forbid me to conclude or believe that the product was fat acid. That the fat was changed appears from the description of the product and its properties, and that this change took place either through highly-heated water or high steam. The change appears to have been a decomposition, but from the description of the properties of the body I cannot, even with my present knowledge, believe it to have been free fat acid.

X Q. 326. Do you make a distinction between fat acid and free fat acid? If so, state what you mean by each, in connection with your foregoing answer.

A. I used the term fat acid because that was in the question, and the term free fat acid because I think it a more correct expression in the present suit. The two expressions in the foregoing answer I consider as identical.

X Q. 327. As a chemist, what changes, if any, do you know to be produced in the decomposition of fats by the action of highly heated water or steam without the production of fat acid?

A. I know of no other without such production.

X Q. 328. Having stated, in answer to X Q. 323, "But now,
451 in the light of Mr. Tilghman's patent, I would suppose that it was decomposed," and having, in your last answer, stated that you know of no decomposition of fats by highly heated water or steam without the production of fat acid, I ask you now whether, in your opinion, fat acid was not produced in Perkins' engine?

A. To form my opinion from theory, fat acid ought, I think, to have been produced. But that the product was not fat acid the properties of the product given in Exhibits 1 and 2 clearly indicate. I therefore cannot go against facts, and believe that fat acid was produced. I can conceive that friction in Perkins' cylinder may have modified the product so that it was not fat acid. In any case I can say that I do not believe it was fat acid.

X Q. 329. And yet you suppose that the fat was decomposed?

A. I do suppose so.

X Q. 330. Now will you state what modification of the product you can conceive of that the friction in the cylinder may have produced?

A. I cannot conceive what other specific products can be produced,

but I meant I only conceived the possibility of modifications by friction.

X Q. 331. Might not one of those modifications have been the combination with the product of "a trace of copper?"

A. Yes; the combination of a trace of copper with an equivalent quantity of fat.

X Q. 332. Would not such trace of copper to some extent indicate that the fat had been acidified?

A. No; it would rather indicate that the oxide of copper had decomposed its equivalent quantity of fat and formed a copper-soap.

X Q. 333. Does not an acid fat more readily attack copper or other metal than a neutral fat?

A. I have no doubt that it would attack copper in the presence of air more readily, and the oxide of copper still more readily than neutral fat.

X Q. 334. In answer to Q. 72 in chief, you say, referring to the fat as changed in Perkins' engine, that "it differs also from (complainant's) in the presence of lime in unknown quantity, and from an unknown source." I will ask you if the fat acid of commerce does not contain lime?

A. I do not know it from my own experience, nor do I know from information of others that it is always present.

X Q. 335. Is it usually present?

452 A. I am not aware that it is, from any source of information.

X Q. 336. Then why, in answer to Q. 43, did you state as follows: "It does contain lime. My authority is Dumas' Chemistry, vol. VI, page 680, Roret's Encyclopedia, page 163?"

(Complainant's counsel objects, that Q. 43 does not refer to the fat acids of commerce generally, but only to the "stearic acid of commerce which has been prepared by the use of lime.")

A. In my answer to X Q. 334 I referred to fats, and did not observe the expression fat acid of commerce; and what is stated as to presence of lime, in answers to X Q. 334 and 335, is intended to refer only to the fats of commerce.

Examination adjourned to to-morrow (Wednesday) at 10 o'clock, a. m.

WEDNESDAY, *March 3d*, 10 *a. m.*

Present, B. C. Tilghman, esq., for complainant; Charles B. Collier, esq., for defendants.

Cross examination of witness resumed:

X Q. 337. Then the fat, as changed in Perkins' engine, in having some lime combined with it, resembled in such respect the fat acids of commerce referred to in your examination-in-chief, did it not?

A. It resembled it, as far as I can determine, only in respect of the content of lime; but the word "some" in the question makes the question ambiguous.

X Q. 338. Did it not also resemble the fat acids of commerce in being soluble in alcohol?

A. It did in being soluble in "hot alcohol."

X Q. 339. Did it not, in possessing these properties, that is, in being soluble in hot alcohol and having in combination with it some lime also, resemble the stearic and oleic acids of defendants' product?

A. The experimenter, in Exhibit 1, states that it resembles Chevreul's acid of fat, not that it is acid of fat "in these respects;" but the balance of the sentence in Exhibit 1, namely, "the alkaline solution is turbid,"

shows that even in these respects there is a difference between it and stearic and oleic acid of defendants, or any fat acid of commerce that I have tried.

X Q. 340. X Q. 339 repeated.

A. It does resemble the stearic, but not the oleic, in the content of lime. It resembles both acids in the solubility specified.

453 X Q. 341. Did you not, in answer to question 41 in chief, state that you examined samples of commercial stearic and oleiac acids furnished by defendants on the 17th of December, 1868, and found that they contained lime?

A. I did so state.

X Q. 342. Would not such fat acids, when burned, leave an ash of carbonate of lime?

A. They did leave such an ash.

X Q. 343. And in this respect they resemble, do they not, the fat as changed in Perkins' engine?

A. They certainly resembled it in that respect.

X Q. 344. In what state of combination do you think the lime existed in the fat as changed in Perkins' engine?

A. As a lime-soap.

X Q. 345. Do you think that the fat, as changed by Perkins' engine, was a pure neutral lime-soap?

A. As I can only judge of it from the experiments detailed in Exhibit 1, I can draw no other conclusion than that it was a lime-soap, with a trace of copper-soap.

X Q. 346. Do you think that the entire product was a combination of lime-soap and copper-soap?

A. Judging from the description of it in Exhibit 1, I think that the entire product in the black, waxy scum, was a mixture of lime-soap, copper-soap, and impurities which are not further described.

X Q. 347. Would a mixture of lime-soap, copper-soap, and impurities, being digested in hot alcohol, leave a "clear solution?"

A. It would, with the exception of the impurities, probably including the trace of copper-soap.

X Q. 348. Does a lime-soap dissolve in hot alcohol and make a clear solution?

A. It does.

X Q. 349. In your deposition given in the original suit against the defendant, Werk, you testified as follows, did you not—page 33, printed copy, answer to Q. 27—"By treating the alleged product of Werk with alcohol, which dissolves the fat acid and glycerine, but which does not dissolve lime-soap," &c.?

A. I did.

X Q. 350. Exhibit 1 states, does it not, that "the cold alcoholic solution, on evaporation, left a substance similar in many respects, but much softer, even fluid?" To what do you think it was similar in many respects?

454 A. It makes that statement. I infer that it refers to the precipitate from the hot alcohol, namely, the grayish, waxy, brittle substance.

X Q. 351. If the mixture treated by hot alcohol was one of lime-soap, copper-soap, and impurities, what was left in the cold alcoholic solution after evaporation?

A. I can only infer from the statement in Exhibit 1 that the similar substance was a mixture of stearic and oleic lime-soaps.

X Q. 352. Would a mixture of lime-soap, copper-soap, and impurities,

being treated by hot alcohol, and the clear solution arising therefrom being set aside, leave flocculi having the lustre and appearance of wax on cooling?

A. It would not without fusion of the flocculi.

X Q. 353. What do you understand by the word "fused" as applied to the flocculi in Exhibit 1?

A. I understand by it, as every chemist would, melted by heat.

X Q. 354. Would a mixture of lime-soap, copper-soap, and impurities, such soaps containing no free fat acids, and being treated in hot alcohol, as described in Exhibit 1, leave flocculi "separating in abundance from it on cooling," such as described in Exhibit 1?

A. Such mixture would leave such flocculi, separating under the conditions stated.

X Q. 355. What would such flocculi be, neutral or acid?

(Complainant's counsel objects, that the question as to the properties of flocculi found in lime-soap in general tends to mislead the witness, and that it should be confined to the flocculi from soap derived from the kind of fats specified in the exhibit, to wit, "a mixture of about equal parts of Russia tallow and olive-oil.")

A. They would be neutral.

X Q. 356. And if neutral, would they, when dried, collected, and fused, give a grayish substance, contracting and cracking as it cooled, with the lustre and appearance of wax, but rather more brittle?

A. I infer that the term grayish indicates a little coloring matter of the nature of which I am ignorant, otherwise I believe that such a hypothetical mixture, treated as stated in question, would give a product with the properties described.

X Q. 357. And if neutral would it dissolve readily in alkalies?

A. It would in strong alkalies, making a turbid solution.

X Q. 358. Then lime-soap formed from a mixture of about equal parts of Russia tallow and olive-oil, being treated or digested in
455 hot alcohol, will yield an abundance of flocculi consisting of neutral fat, will it?

A. Lime-soap from any source could not yield neutral fat.

X Q. 359. Having stated that these flocculi, described in Exhibit 1, were in your opinion neutral and not acid, what do you mean by neutral?

A. That they were not acid.

X Q. 360. Were these flocculi neutral lime-soap?

A. I believe them to be such from the experiments detailed.

X Q. 361. Has neutral lime-soap the "lustre and appearance of wax" after being melted?

A. It has a resemblance to wax both in appearance and lustre.

X Q. 362. Is it "rather" lighter than "water?"

A. Lime-soap may be made lighter, of the same specific gravity, or heavier than water.

X Q. 363. Please answer the last question, referring to the flocculi in Exhibit No. 1, and treated as therein described, supposing them to have been neutral lime-soap as stated by you?

(Complainant's counsel objects to the witness being called upon to describe any properties of the flocculi in Exhibit 1, other than those specified, as it is impossible that witness can ever have seen or examined said flocculi.)

A. Supposing it to have been lime-soap, the property enunciated in X Q. 362 shows that it was in the condition of lighter than water, as given in answer to X Q. 362.

X Q. 364. Supposing it to have been a neutral lime-soap, from whence do you infer from Exhibit 1 that it obtained its lime?

A. Not having been present, and knowing nothing of the circumstances or materials used further than are detailed in Exhibit 1, it is impossible that I could even conjecture the source of the lime with any degree of probability.

X Q. 365. Might not the water used in said engine have contained carbonate of lime, and, if so, would not this account for the presence of lime in such flocculi?

A. It is possible the water may have contained carbonate of lime, although not likely, but I am not aware that carbonate of lime can decompose a neutral fat to form lime-soap, unless it be at a high pressure and temperature, and even under these last conditions I do not recollect an experiment upon this point.

X Q. 366. Does a lime-soap burn like fat?

A. It will when heated, in a similar manner as fat when heated.

456 X Q. 367. And when burned would it leave only a slight ash of carbonate of lime?

A. It would leave when burned an ash of about $\frac{1}{6}$ to $\frac{1}{10}$ of its weight of lime or its carbonate, and if the quantity of lime-soap were small the quantity of ash might be expressed as "slight."

X Q. 368. Was not Mr. Faraday eminent as a chemist and man of science?

A. He was very eminent as such.

X Q. 369. Who was Johann Gottfried Dingler?

A. He was the editor of a German technical journal.

X Q. 370. Having stated in answer to questions 67 and 68 in chief, "that chemists did not as a matter of fact become acquainted with that fact, to wit, the decomposition of fats into fats acids and glycerine by the action of water at a high temperature and pressure, from the publication of Exhibits 1, 2, 3, and 19, and that when new chemical facts or discoveries are published, they are collected and embodied in standard chemical treatises, which represent the state of the science at the date of their publication," I will ask you whether you did not, together with Professor W. L. Faber, edit and publish an edition of Regnault's Chemistry in A. D. 1860, and whether such work is not recognized as a standard chemical treatise?

A. I did edit the same, conjointly with Mr. Faber, and it is recognized as a good standard treatise.

X Q. 371. Was not the complainant's patent published prior to the publication of your said work?

A. It was.

X Q. 372. Is any mention made in your said treatise of the complainant's process?

A. I know of no reference to it in Regnault's work, of which my edition is a mere translation with a few notes.

X Q. 373. Leaving now the Perkins engine exhibit, will you please state whether water will dissolve or separate oleic acid from a mixture of stearic, margaric, and oleic acid combined as a lime-soap?

A. It will not.

X Q. 374. In the saponification of fatty bodies by lime, in what state of combination with the lime will the oleic acid be found?

A. As oleate of lime.

X Q. 375. In such saponification, that is with a full equivalent of lime if lime-soap is the product, will all the acids of the fat, to

457 wit, the stearic, margaric, and oleic acids be combined with the lime so as to form a lime-soap?

A. They will form a mixed lime-soap.

Q. 376. If a product of lime saponification be presented to you, and be treated by water, and as the result of such treatment oleic acid is dissolved by the water, what inference would you draw therefrom?

A. I cannot suppose such solution of oleic acid in water, as it is contrary to experience.

X Q. 377. In Defendants' Exhibit No. 6, what is stated as to the separation of the stearic and margaric acids from the oleic acid under the first process?

A. "We decompose by water the soapy mass obtained by saponifying grease, tallow, etc., by an alkali; the water dissolves the oleate to the exclusion of the great mass of the stearic and margaric acids, which are left behind in the state of super salts."

X Q. 378. What do you understand by the word "oleate" in that sentence?

A. Oleate of alkali, that is oleic acid combined either with soda or potassa.

X Q. 379. What kind of alkali do you infer from said exhibit was used by Gay-Lussac, and Chevreul?

A. I infer that it was either potassa or soda, from the solubility in water of the oleate mentioned.

X Q. 380. If it was lime, the water would not have dissolved the oleate, would it?

A. It would not have dissolved the oleate of lime.

X Q. 381. Is it not stated in said exhibit, as follows: "We saponify the fatty bodies destined for illumination, &c.," and is it usual in such saponification to use either potassa or soda?

A. It is not now usual.

X Q. 382. Was it ever so?

A. It was so described in the first patent of Gay-Lussac & Chevreul, January 5th, 1825.

X Q. 383. Is not the word "saponification" applied in France indiscriminately to the decomposition of fats, whether by heat, sulphuric acid, lime, or other process?

A. I have seen it so applied in French works, but whether universally so applied in France I do not know.

X Q. 384. The use, then, of the word "saponification," in the patent of Gay-Lussac & Chevreul, does not necessarily imply that a full equivalent of alkali was used, does it?

458 A. I think that it does, because no other method of saponification than by alkali or oxide of lead was known at the date of said patent, and the fat was thoroughly saponified.

X Q. 385. Turning to Defendants' Exhibit No. 7, do you infer that the treatment of tallow, as remarked by Mr. Kufahl, was with water or steam, or neither?

A. I infer it to have been by means of steam, because those are the words used in the exhibit.

X Q. 386. And do you infer that it was in a closed vessel?

A. I do, because it is stated to be under pressure of several atmospheres,

X Q. 387. And if tallow is treated in a closed vessel by steam, under a pressure of eight to ten atmospheres, do you not believe that it will be decomposed?

A. I infer such a result under the conditions named.

X Q. 388. Do you not also infer that the resulting products of such decomposition would be free fat acids and solution of glycerine?

A. I could only infer such result from Scharling's statement, in Exhibit 12, in which he distilled fats with highly-heated steam, and alleges that he obtained fat acids as a product; but whether such result could be produced by mere steam, highly heated, or by distillation by highly-heated steam, I cannot say. As relates to the solution of glycerine, I can make no inference at all.

X Q. 389. What is the temperature corresponding to a pressure of "eight to ten atmospheres?"

A. From 350° to 367° Fa'r.

X Q. 390. Do you believe, as the result of your experiments and research in this branch of science, that in such decomposition of tallow in a Papin's digester, by the action of steam, at a pressure of eight to ten atmospheres, corresponding to 350° F., the glycerine of the tallow would be destroyed?

A. I cannot answer from my experiments, in which I treated fat with steam at about 600° Fa'r., and not lower. From my research into Wilson & Paine's patent, No. 1624, I believe that glycerine is not decomposed in a current of steam at 550° or 600° Fa'r. So far the answer refers to a current of highly-heated steam. I cannot form any opinion as to the action of steam at the temperature named in the question, in a closed vessel like Papin's digester.

X Q. 391. Do you believe that glycerine is more likely to be destroyed in a Papin digester, by the action of steam, at a temperature of
459 350° F., than in a distillatory apparatus, such as used by Wilson & Paine, at a temperature of from 550° to 600° F.?

A. On general chemical principles, I should say yes; because in said digester it would be retained for a considerable time exposed to that temperature, whereas, in distillation, it is rapidly carried beyond the influence of the heated steam.

X Q. 392. For how long a time is it exposed to such temperature in the process practiced by Mr. Ropes, as described by him on page 110, original suit against Werk?

(Complainant's counsel objects that the question refers to the action of steam in a digester, whereas, in the process of Ropes, referred to, a large quantity of water was present.)

A. For six to twenty hours.

X Q. 393. Can you state for how long the last portion of the fats, decomposed by Wilson & Paine's process, is exposed to the temperature of from 550° to 600°?

A. I do not find it stated how long a time is required to distil over the whole fat decomposed.

X Q. 394. Do you not believe that in an ordinary charge or quantity of fat, as used by manufacturers, it would require some hours to distil the entire fat according to Wilson & Paine's process?

A. I think it would.

X Q. 395. And would not the glycerine, in such process, be exposed to the action of steam at 550° to 600° F. for some hours?

A. By no means, for the decomposition of a fat into fat acid and glycerine is undoubtedly successive, and the separated fat acids and glycerine are carried over into the cooler by the current of steam as fast as formed.

X Q. 396. Have you not yourself heated fat to 550° to 600° F., in the absence of either water or steam, without destroying the glycerine of the fat?

A. I don't recollect any such experiment in an open vessel. I must, however, have performed such an experiment, as I find it mentioned on page 40 of plaintiff's testimony in the case against R. G. Mitchell.

X Q. 397. How long do you think the glycerine, resulting from the decomposition of tallow as in Exhibit 7, would have to be exposed to the temperature of 350° F. of steam to be destroyed?

(Complainant's counsel objects, that Exhibit 7 does not mention the presence of glycerine.)

460 A. If glycerine had been produced, of which there is no mention in Exhibit 7, I cannot say how long it would require for it to be decomposed, having no data on which to form an opinion.

X Q. 398. Having stated that you inferred that there was or would be a decomposition of fat treated as in Exhibit 7, would not both fat acid and glycerine be produced?

A. I can make no inference in relation to solution of glycerine, or glycerine unaltered, having no data on which to form an opinion. If there was decomposition of the fat with production of fat acid, I would infer that glycerine was also produced at the same moment of time.

X Q. 399. And do you not believe that there was decomposition of the fat, treated as described in Exhibit No. 7?

A. I believe it possible, but have no evidence that it was so.

X Q. 400. Do you not believe it probable?

A. More probable than improbable.

X Q. 401. Passing now to Defendants' Exhibit No. 8, is not the fact there announced that, by the action of a current of steam, the transformation into fat acids and glycerine of the last portions of the neutral fats is finished?

A. It is so announced "at this temperature," and under the influence of the current of steam, &c.

X Q. 402. Passing now to Exhibit No. 14, I call your attention to the last paragraph contained in said exhibit, on page No. 17, printed copy, and ask you whether the description of the product of the process of Mr. Appert is descriptive of the properties of tallow?

A. Mr. Appert describes it himself as tallow, and it appears to me from the description to be similar to the material of pressed lard candles.

X Q. 403. Do you mean to be understood that there was not a partial decomposition of the tallow, treated according to Appert's patent?

A. Neither from the patent itself, nor from any other source, can I suppose that a decomposition of the fat took place, not even a partial one.

X Q. 404. Passing now to Exhibit No. 17, David Walther's patent, and with the patent before you, I ask you if Mr. Walther did not use a closed vessel?

A. He did.

Adjourned to to morrow (Thursday) at 9½ a. m.

461 THURSDAY, *March 4th*, 9½ *a. m.*

Present, B. C. Tilghman, esq., for complainant: Charles C. Collier, esq., for defendants.

Cross-examination of witness resumed.

X Q. 405. Calling your attention to Walther's process for purifying vegetable and animal oils, as described in his patent, which description commences with the words, "For purifying vegetable and animal oils according to my said improvements," (page 11, printed copy,) you understand from such description, do you not, that the oils to be treated are to be gradually heated in a vessel, "S," by waste or fresh steam?

A. I so understand it.

X Q. 406. You further understand, do you not, that when so gradually heated, saturated lime-water, a transparent solution, is poured into the heated oil, and stirred, so as to intermix the oil and water as much as possible, the quantity of such saturated lime-water being about one-tenth the quantity of oil?

A. I so understand it.

X Q. 407. You understand further, do you not, that the mixture of oil and lime-water is then run down from the heating vessel "I" into the vessel "A," and that the quantity of oil will then fill the vessel "A" $\frac{1}{2}$ to $\frac{2}{3}$ full?

A. I infer that that is so, from the wording of the patent.

X Q. 408. You understand further, do you not, that the valve on the top of vessel "A" is then closed and weighted, at first at the rate of two atmospheres, or 30 pounds; that high-pressure steam in divided currents is then admitted into vessel "A" near its bottom, and that the load on the valve is increased by degrees, until in the course of four or five hours the load will be equal to four atmospheres, or sixty pounds?

A. I so understand it.

X Q. 409. You understand further, do you not, that if, in the language of the patentee, "Impurities are more fixed in the oil," the patent contemplates increasing the pressure to five atmospheres or 75 pounds, and carrying on the operation for an additional length of time at such increased pressure, for say another hour, making six or seven hours?

A. I so understand it.

X Q. 410. Suppose now you should to-day be called on to perform an operation upon "vegetable" or "animal oils," in the precise
462 manner as stated in the foregoing questions and answers from No. X 405 to X 409, both inclusive, what in your own present opinion would you obtain as products in drawing off the contents from vessel "A" at the end of seven hours?

A. (From my knowledge of the discovery by plaintiff of the decomposition of fats by highly heated water into fat acid and glycerine,) I suppose I would obtain a product containing a quantity of unaltered oils, mixed with free fat acid and glycerine together with a quantity of lime-soap corresponding to the amount of lime used.

(That portion of the foregoing answer included in parenthesis, objected to defendants' counsel, and question repeated.)

X Q. 411. X Q. 410 repeated.

A. Since the questions asked what would be my present opinion, and since that opinion must be based on knowledge, and since that knowledge embraces the principles enunciated in Mr. Tilghman's patent, namely, the decomposition of fatty matters into fat acids and glycerine by the action of highly-heated water, it is impossible to give an opinion at the present time, without basing it on said principle enunciated in Tilghman's patent. I therefore am obliged to adhere to my answer, as the only one that it is possible for me to give.

X Q. 412. And to what in your present opinion would the production in Walther's process of free fat acid and glycerine be due?

A. To the action of highly-heated water on the oils, if such fat acid and glycerine were produced as I have above supposed they were.

X Q. 413. If, then, Mr. Walther, in 1840, treated vegetable or animal oils in the manner described in his said letters-patent, is it not your present opinion that he produced free fat acids and solution of glycerine in a closed vessel by the action of water at high temperature and pressure?

(Complainant's counsel objects, that inasmuch as there are several temperatures, pressures, and lengths of time mentioned in said patent, the question should specify the particular temperature, pressure, and time to which it refers.)

A. Taking the highest pressure named and corresponding temperature, namely five atmospheres, I infer from my present knowledge that he should have obtained some free fat acid and glycerine in a closed vessel by the action of water at a high temperature and pressure. I do not know what would be produced at lower pressure and temperature.

463 X Q. 414. Calling your attention now to the process of Mr. Walther, described on page 14 of his printed patent, commencing with the words "And for purifying fats and tallow, the same course is followed, except as to the addition of lime-water," and ending with the 30th line on said page, what in your opinion would be the product resulting from the treatment of fats and tallows as therein described?

A. In the first place the process alluded to on page 14 gives the highest pressure used as four atmospheres, or about 308° Fa'r., which is lower than the lowest temperature at which I have acted upon fats by water, and I therefore cannot give an opinion as to the nature of the resulting product, whether it would contain free fat acid and glycerine or not.

X Q. 415. Upon the supposition that the words in the first line of said paragraph, on page 14, to wit: "And for purifying fats and tallows, the same course is followed;" contemplate the highest temperature and pressure, and length of time, as employed for the purification of vegetable and animal oils, as described on page 13, what, in such case, is your opinion as to the resulting product of such treatment?

A. If the words contemplated such highest temperature, and pressure, and time, as mentioned on page 13, my opinion, based on present knowledge, is, that the resulting product would contain free fat acids and glycerine.

X Q. 416. Passing now to Defendants' Exhibit No. 20, to wit, patent of William Charles Hirschfeld, will you please state the action of sulphuric acid on tallow, as employed in the ordinary sulphuric-acid decomposition of fats?

A. It acts first in its acid character by neutralizing any bases that may be present, lime or other oxides, and next, by eliminating the elements of glycerine from the fats to form what is usually called, I believe, sulpho-glyceric acid, by combining with those elements.

X Q. 417. Do you know what proportion or percentage of sulphuric acid is employed in such processes?

A. From eight to sixteen per cent. of the weight of oil, as stated by Payen, page 769 of the Chimie Industrielle.

X Q. 418. And is it not highly concentrated acid?

A. Payen says in the cited page, concentrated acid.

X Q. 419. Calling your attention now to the following paragraph in Exhibit 20, to wit: "But if the tallow is to be decomposed at

464 the same time, there is put to a zentner (hundred-weight) of raw material two pounds of English sulphuric acid, which is diluted with thirty-two pounds of rain-water," will you please state what, in your opinion, would be the resulting products of such decomposition?

A. Aside from the neutralization of bases accidentally present, my opinion is, that the sulphuric acid would eliminate and combine with a portion of the elements of glycerine, the remainder of the acid uniting with the elements of the fat acids set free from such glycerine.

X Q. 420. And what would become of that portion of the elements of glycerine with which the sulphuric acid has not combined?

A. I believe they would remain united with the fat acid, constituting unaltered fat.

X Q. 421. Then your answers refer and imply only a partial decomposition of the tallow, do they not?

A. They do.

X Q. 422. Upon the hypothesis that the decomposition mentioned in the patent, Exhibit 20, is not partial but total, then what, in your opinion, would be the resulting products?

A. I cannot imagine any other decomposition unless the temperature and corresponding pressure in the vessel had been at least 320° Fa'r., as that is the lowest point at which I know from experience that water will decompose fat into free fat acids and glycerine; and since the only other substances present, aside from the sulphuric acid and its resulting products, are water and fats, I infer from the other condition I have stated, namely, 320° Fa'r., that the resulting products of decomposition would be free fat acids and glycerine. If, therefore, the balance of the fat was decomposed as hypothetically stated in the question, I infer two things: first, that the products would be free fat acids and glycerine, and, second, that the temperature must have been at least 320° F.

X Q. 423. And upon such hypothesis, would not the free fat acid and glycerine products be the result of water at a high temperature and pressure in a closed vessel?

A. They would be, I believe, under such hypothesis.

Redirect examination.

Q. 424. Do you not find it stated in Exhibit 20, "That when sulphuric acid is used, the further treatment remains the same as mentioned above," and do you not understand therefrom that the
465 temperature, pressure, and time of the operation, when sulphuric acid was used, were the same as when water alone was used as described in the first part of the Exhibit 20?

A. I find it stated in the exhibit that the treatment remains the same, and I understand from this expression that the temperature, pressure, and time of operation, are the same when sulphuric acid was used as when rain-water alone was used, as described in the first part of the exhibit.

Q. 425. Do you not find it stated that in the operation described when water alone is used the product is "tallow," or "pure" or "purified" tallow?

A. It is so stated.

Q. 426. Do you not infer and understand therefrom that when water alone was used, the temperature, pressure, and time of the operation were not sufficient to decompose the fat, or to produce free fat acid and glycerine?

A. I infer and understand that there was no decomposition produced in the process where water alone was used, and that therefore the temperature, pressure, and time were not sufficient to decompose the fat, or to produce free fat acid and glycerine.

Q. 427. If, then, the temperature, pressure, and time of the operation with sulphuric acid were the same as those with water alone, it follows, does it not, that the temperature, pressure, and time of the operation with sulphuric acid were not sufficient to cause the decomposition of the fat into fat acids and glycerine?

A. It follows as a necessary consequence.

Q. 428. Is there any other difference between the first and second process, described in Exhibit 20, except the addition of the two pounds sulphuric acid to one hundred-weight of tallow in the second process?

A. There is no other difference.

Q. 429. If, then, the product of the second operation differs from the product of the first operation in being "decomposed," must not such decomposition, whether partial or total, necessarily be due to the addition of the sulphuric acid?

A. As the only difference between the two lies in the use of two pounds of sulphuric acid, no other decomposition could take place than what such sulphuric acid would produce.

Q. 430. Please examine Walther's patent, page 12, lines 20 to 25, printed copy, and state whether he there explains what he means by the term two atmospheres, and state in pounds per square inch, as
466 understood by engineers in this country, what pressure that is equal to?

A. He does explain what he means by the term "two atmospheres," and that is equal to fifteen pounds pressure per square inch, as understood by engineers in this country.

Q. 431. Please state in pounds per square inch the pressure corresponding to the terms three, four, and five atmospheres as used by said patentee in the parts of his specification subsequent to the said explanation.

A. The pounds pressure corresponding to his terms three, four, and five atmospheres are, 30 pounds for three atmospheres, 45 pounds for four atmospheres, and 60 pounds for five atmospheres.

Q. 432. State whether in your answers to cross-questions 408, 409, and following, you were misled by the assumption in said questions, that the pressure of two atmospheres was thirty pounds, four atmospheres was sixty pounds, and that five atmospheres was seventy-five pounds to the square inch respectively?

A. I supposed in my answers to said questions that the pressures in pounds named in said questions were such as are understood by engineers in this country, and my answers were framed in that view, and in so far I was misled by the questions.

Q. 433. State whether on the continent of Europe the term two atmospheres pressure, as applied to steam-boilers, means fifteen pounds to the square inch, as understood in England and the United States, and whether such distinction is well known and recognized in scientific and technical treatises.

A. It means what we term fifteen pounds to the square inch in England and the United States, and such distinction is well known and recognized in such treatises.

Q. 434. Examine Walther's patent and say whether it expressly states that the invention was a communication from a foreigner residing abroad?

A. It so states on the first page of the printed copy of the patent.

Q. 435. Would a chemist or manufacturer possessed of the information on the subject current prior to 1854, if he should read Walther's patent, become acquainted with the fact that fats could be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

(Question objected to by counsel for defendants, inasmuch as the wit-
467 ness is not a manufacturer, and for the further reason that the witness should be confined to the information as possessed by himself prior to such time, and for the further reason that the result of such process is the question to be considered by the court.)

A. He could not possibly have become acquainted with that "fact" from reading that patent.

Q. 436. Referring to Exhibit S, state whether the transformation of the neutral fat into fat acid and glycerine, there referred to, is not explained in the context of the original work, (Payen,) to take place from fat previously treated with from eight to sixteen per cent. of sulphuric acid.

A. It is so stated.

Q. 437. If a chemist or manufacturer possessed of the information on the subject, as current prior to 1854, should read Defendants' Exhibit 7, would he thereby become acquainted with the fact that fats could be decomposed into fat acids and glycerine, by the action of water at high temperature and pressure?

(Same objection as to Q. 435.)

A. He could not have become acquainted with that fact from reading that exhibit.

Q. 438. In your answer to X Q. 387 you state that you infer that tallow, treated as described in Defendants' Exhibit 7, would be decomposed. Do you make this inference from Exhibit 7 itself, or from any facts publicly known, as far as you are aware, prior to complainant's patent, or do you make it from information derived from complainant's patent?

A. My inference was based on the information derived from complainant's patent, and not from the knowledge of anything previously known to his patent. My inference is not made from the exhibit itself.

Q. 439. Referring to Defendants' Exhibit 6, have you any doubt as to whether or not the saponification there spoken of was intended to be a complete saponification and saturation of the fatty body of alkali? Quote from the exhibit the term repeatedly used in describing the product of said operation.

A. I have no doubt that complete saponification is intended. The term "soap" is repeatedly used in describing the product of the saponification.

Q. 440. Referring to X-q. 370, please explain your connection with the American edition of the Translation of Regnault's Chemistry of 1860, there spoken of, and also your connection with any previous edition of said work.

468 A. I have had nothing to with any edition of said translation, except with the first, which was published in 1852.

Q. 441. Referring to X-questions 294, 295, 296, 299, 300 and 301, and your answers thereto, please state how long it has been known, and by whom it was first announced, that the chemical principles or affinities involved in the formation of fat acids and glycerine from neutral fats were this, that the elements of the fat acid and glycerine respectively assumed or took up or combined with the elements of water.

(Question objection to by counsel for defendants, for the reason that, inasmuch as the witness has testified in his cross-examination that he inferred such chemical affinities and combinations took place, in several of the processes referred to in defendants' exhibits, it is impossible that he should be able to state that the persons conducting such processes did not know of the occurrence of such chemical affinities and combinations, and that any deduction drawn by the witness to the contrary thereof is argument and not testimony.)

A. It has been known for more than forty-eight years, and was first announced by Chevreul as one of the results of his investigation of fatty bodies.

Q. 442. In the formation of fat acids and glycerine by the process of

alkaline saponification and subsequent decomposition by acids, as described in Gay-Lussac & Chevreul's patent of 1825, Defendants' Exhibit No. 6, are these chemical affinities involved?

A. They are.

Q. 443. In the formation of fat acids from neutral fat by distillation by heat alone, without the presence of steam, as in the process of Bussy & Lecanu, referred to in the context to Defendants' Exhibit 8, Payen, page 766, are these same chemical principles and affinities involved so far as relates to the formation of fat acid; if so, whence, in this case, is the water derived, which is taken up by the elements of the fat acid?

A. The same chemical principles and affinities are involved so far as relates to the formation of the fat acid, and the elements of water taken up by the elements of the fat acid are derived from the decomposition of the glycerine.

Q. 444. In the formation of fat acids by distillation by means of superheated steam, as described in the processes of Du Brunfaut and Scharling, are these same chemical principles and affinities (the taking up of the elements of water by the elements of the fat acid) involved?

469 A. They are.

Q. 445. In the formation of fat acids by the sulphuric saponification process of Fremy, Payen, page 766, Defendants' Exhibit 8, are these same chemical principles and affinities (the taking up of the elements of water by the elements of the fat acid) involved?

A. They are involved in that process.

Q. 446. In the formation of fat acids and glycerine by distillation with superheated steam, at such temperatures that the glycerine is not destroyed but distilled over with the fat acids, as in the process of Wilson & Paine's patent of 1854, are these same chemical principles and affinities involved?

A. They are involved in the process referred to in the question.

Q. 447. Do I, then, understand you to say that in each of these six processes of forming fat acids, to wit, first, the alkaline saponification of Chevreul; second, the distillation from fat by heat without steam by Bussy & Lecanu; third, the distillation from fat with superheated steam of Du Brunfaut & Scharling; fourth, the sulphuric saponification of Fremy; fifth, the decomposition by water at a high temperature and pressure of Tilghman; sixth, the distillation of both fat acids and glycerine from fats by superheated steam of Wilson & Paine; the said chemical principles and affinities are involved, to wit, the taking up of the elements of water by the elements of the fat acid, and (wherever glycerine is formed) by the elements of the glycerine?

A. In each of the six processes the said chemical principles and affinities are involved.

Q. 448. Did the announcement by Chevreul, more than forty-eight years ago, of the chemical principles and affinities involved in the formation of fat acids and glycerine, (the taking up of the elements of water by the elements of the fat acid and glycerine respectively,) make known to the public all, or any, of the five processes last named in question 447; or were said five processes discovered and announced by different persons, and at successive intervals of time during the forty-eight years since Chevreul's announcement?

(Question objected to, as not re-examination touching any matter embraced in the cross-examination.)

A. That announcement by Chevreul did not make known to the pub-

lic any of the five processes referred to in question; but said five processes were discovered and announced by different persons and at successive intervals of time since Chevreul's announcement.

470 Q. 449. Admitting that the chemical principles and affinities involved in the formation of fat acids and glycerine, the taking up of the elements of water by the elements of the fat acid and glycerine respectively, have been known for forty-eight years, is it any the less true that the method or process of decomposing fats into fat acids and glycerine, by the action of water at a high temperature and pressure, was unknown prior to complainant's patent?

(Question objected to, for the reason that the novelty of the complainant's process, under the circumstances supposed, is a question of law to be passed upon by the court, and not one of fact to be testified to by a witness.)

A. The method or process of decomposing fats into fat acids and glycerine by the action of highly heated water was unknown prior to complainant's patent, as far as all my researches have been extended, although the principle involved in the assumption of the elements of water by the elements of fat acids and glycerine respectively, without reference to any particular process for separating the elements of fat acids from the elements of glycerine in fats, was made known by Chevreul, in the course of his researches prior to 1820.

Q. 450. Referring to your answers to X Q. 192 and 193, state whether the rates of expansion of water and fatty bodies by heat are well-known facts, published in standard works, and name any such works.

A. They are well known facts and published in standard works, namely: in Graham's Chemistry, Philadelphia edition, 1843, page 28; Brande's Chemistry, London, 1841, page 137; Booth's Dictionary, Philadelphia, 1850, page 618.

Q. 451. Could a manufacturer ascertain from such known facts how much room to allow for the expansion of the water and fat by heat in his vessel, without any experiment?

A. He could without experiment.

Q. 452. If a common safety-valve, properly loaded, were attached to the vessel, would the expansion of the water and fat by heat cause the vessel to burst, even supposing that sufficient room for such expansion had not been allowed in the vessel?

A. The vessel could not burst in this case.

Recross-examination:

X Q. 453. Having stated in answer to Q. 447, re-examination, that the same chemical principles and affinities are involved in the
471 six processes referred to in Q. 447, that is, the taking up of the elements of water by the elements of fat acid and glycerine, wherever glycerine is formed, was not the taking up of the said elements of water accomplished in said six processes, when the elements of water were at a high temperature?

A. In some the elements of water were taken up at a high temperature; in others not.

Q. 454. Having stated in your cross-examination, in reference to some of the processes described in defendants' exhibits, that free fat acids and solution of glycerine would be produced in such respective processes by the elements of free fat acids and glycerine respectively, combining with the elements of water, will you now state wherein the chemical principles and affinities involved in such processes differ, if at all, from the chemical principles and affinities involved in the complainant's process?

(Complainant's counsel objects that the witness's attention should be called to the particular process or processes meant to be referred to.)

A. One chemical principle is involved in all the processes where fat acids and glycerine, if any, are obtained from fat, namely, the assumption of the elements of water by the elements of the fat acids and of glycerine, if that be formed. Another chemical principle consists in the mode of separating the elements of fat acids from the elements of glycerine, and in this respect complainant's process differs from all others in employing highly-heated water to separate those elements. In some cases I have made inferences, but not assertions or statements, as to the production of fat acids and glycerine if produced in defendant's Exhibits.

X Q. 455. If fat acid and glycerine were produced in Walther's process, what chemical differences, if any, existed in their production from their production in complainant's process?

A. If they were so produced, the principle of production would be similar in Walther's process to that in complainant's, but I have never made an experiment on the separation of fats into fat acids and glycerine by the action of highly-heated water as low as the highest temperature expressed by the highest pressure named in Walther's patent. I therefore answer the question as hypothetically stated, and not from fact.

X Q. 456. In answer to X Q. 246, you say in part as follows: "This last depends upon a principle very generally admitted in
472 chemistry, that it is more difficult to commence a decomposition than to continue it, and that when once begun it goes on more rapidly." This being true, might not water at a given temperature and pressure fail to decompose fats in one case, and at the same temperature and pressure in another case, being aided by some other decomposing agent, complete and perfect the decomposition of the fat?

A. I believe it to be both true and untrue; for example, if fat, water, and a very small quantity of lime be heated together at the temperature of 212°, lime-soap would be formed until the lime was saturated, but I do not believe that one particle more of fat would be decomposed, however long the boiling at 212° might be continued. Anywhere below the temperature at which water will decompose fat into fat acids and glycerine, I do not believe that the presence of any other decomposing agent would complete and perfect the decomposition of the fat, beyond the decomposing power of such agent.

Examination adjourned to to-morrow (Friday) morning at 9½ o'clock.

FRIDAY, *March 5th*, 9½ *a. m.*

Present, B. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

Re-cross-examination resumed:

X Q. 457. Hirschfeld says that by the second process named in his patent the tallow was "decomposed;" and in the same connection uses the words "decomposed mass," does he not?

A. He does; virtually so.

X Q. 458. Assuming that the word "decomposed," as used by him, contemplates a complete decomposition of the tallow so treated, do you not, as a chemist, know that the quantity of sulphuric acid used by him was entirely inadequate to effect such decomposition; that it was a chemical impossibility?

(Complainant's counsel objects to the witness being asked as to what

he "knows" about a product which he has never seen, and about which he is called upon to exercise his imagination.)

A. (The assumption of "complete decomposition of the tallow" is not warranted by the use of the word "tallow" for the product obtained in the process four several times;) but on the supposition of complete decomposition it was chemically impossible that the quantity of sulphuric acid used could have effected such decomposition.

473 (That portion of the foregoing answer contained in the parenthesis objected to by defendants' counsel as irresponsive to the question, and question repeated, and the witness is requested to answer the questions addressed to him upon the assumption of defendants' counsel in such questions.)

X Q. 459. X Q. 458 repeated.

A. On the assumption stated in the question, I believe it chemically impossible that the amount of sulphuric acid used should have effected such decomposition.

X Q. 460. Upon the same assumption do you not also know that free fat acids and solution of glycerine were produced?

(Complainant's counsel objects as in reference to X Q. 458.)

A. On such assumption, apart from the decomposition of a portion of the fat by the sulphuric acid, I believe that free fat acids and solution of glycerine must have been produced.

X Q. 461. And if produced, do you not also know that such production of free fat acids and solution of glycerine was the result of the chemical power of water at a high temperature and pressure in a closed vessel?

(Objected to as to X Q. 458.)

A. On the assumption that all the fat was decomposed, from the description of the process given in the patent I believe that a portion would be decomposed by the sulphuric acid, and that the balance would be decomposed into free fat acids and glycerine, if sufficient rain-water had been poured upon the fat; but if insufficient, a portion of such balance would be decomposed, as just stated, by highly-heated water into free fat acids and glycerine, and the other portion of such balance by highly-heated steam.

X Q. 462. "It is a principle very generally admitted in chemistry that it is more difficult to commence a decomposition than to continue it, and that when once begun it goes on more rapidly," is it not?

A. It is, as stated in my answer to X Q. 246.

X Q. 463. Sulphuric acid acts upon fats to decompose them, does it not?

A. It does, when heated therewith.

X Q. 464. Assuming that the tallow was decomposed in Hirschfeld's second process, (the assumption being a complete decomposition,) the sulphuric acid would commence such decomposition, would it not?

A. I believe it would, from its powerful affinities.

474 X Q. 465. And such decomposition being thus commenced by the sulphuric acid, the water would thereby be enabled more readily, easily, and rapidly to continue such decomposition, would it not?

A. Under the assumption in the question, water, or water and steam, would be so enabled.

X Q. 466. Upon the same assumption as in X Q. 464, is not the inference natural that the decomposition in Hirschfeld's second process was commenced by the sulphuric acid, and continued and completed by the highly-heated water?

A. Under such assumption the inference is natural that it was con-

tinued and completed either by highly-heated water, or partly by highly-heated water and partly by high steam.

X 467. Assuming that in Hirshfeld's first process there was no (or but a partial) decomposition, and that in his second process there was a complete decomposition, is not the fact of such complete decomposition, in such second process, to be accounted for on the chemical principle stated in cross-question 462, to wit, that the sulphuric acid used in the second process commenced the decomposition which the water was thereby enabled to complete?

(Complainant's counsel objects that the assumption in the question that in first process there was a partial decomposition is contradicted by the exhibit; also, that the complete decomposition in the second process is stated in the question as a fact when it is a mere assumption.)

A. On the assumption of no, or but a partial, decomposition in the first process, and on the assumption that there was a complete decomposition in the second process, I would account for such decomposition on the principle enunciated in Cross-question 462, that it was completed either by water, or by water and steam.

X Q. 468. Passing now to Defendant's Exhibit No. 17, Walther's patent, what force or pressure was exerted by the atmosphere surrounding vessel "A," described in said patent?

A. It is always taken to be fifteen pounds to the square inch.

X Q. 469. Then if the steam "about to be admitted into the vessel 'A' can only be accumulated therein until it acquires twice as much elastic force therein as the atmospheric air without," it would have to exert a pressure of thirty pounds per square inch to escape, would it not?

A. It would, according to the mode of expressing such press-
475 ure used on the continent of Europe, but it would be expressed as fifteen pounds to the square inch in England and the United States, because in these last-named countries they commence to state the pounds of pressure per square inch when the water, in an open boiler, commences boiling at about a temperature of 212° Fa'r., when the elastic force of the steam just equals the pressure of the atmosphere.

X Q. 470. From your interpretation of Walther's patent, what is the highest degree of temperature and pressure contemplated by him?

A. For oils the highest is sixty pounds pressure, and for fats and tallows forty-five pounds pressure per square inch, and their corresponding temperatures, as given in answer to question 22 in chief, to wit, from 308° F. for the former pressure, to 293° F. for the latter.

X Q. 471. In answer to cross-question 224 you state as follows: "If I wished to perform the operation at the lowest temperature named in the patent in an ordinary boiler-apparatus, I would bring the mixture of such fat and water in such apparatus at once to somewhat over the temperature of 300° F., when I know from my own experiments on the subject I would obtain a decomposition of fats into fat acids and glycerine by the action of water. The temperature named is what I would term the lowest degree for the expression high-pressure." In answer to cross-question 225 you say, "This, therefore, (to wit, about sixty pounds pressure,) I consider to be the lowest degree stated in the patent." According, therefore, to your interpretation of the complainant's and Walther's patents, the latter contemplates the employment of a degree of high-pressure embraced in and contemplated by complainant's patent, does it not?

A. I have only stated in my answers what I considered to be about the lowest point at which the term high-pressure would be employed, say about sixty pounds pressure, which is the highest named pressure

in Walther's patent for oils. I would, therefore, under my view of the commencement of high-pressure, say that this highest pressure named by Walther for oils was the commencement of high-pressure, but that the highest pressure named for fats and tallows, to wit, forty-five pounds pressure, did not come in the category of high-pressures. According to my view, therefore, Walther's patent contemplates the employment of a degree of high-pressure as his highest degree for
476 oils which is contemplated by complainant's patent as the lowest of complainant, while Walther's highest degree for "purifying fats and tallows," namely, forty-five pounds pressure, is not contemplated by complainant's patent. But, in the answers to questions referred to in the Cross-question 471, I have only stated my personal opinion, which may be different from that of engineers and manufacturers.

X Q. 472. Calling your attention now to the following paragraphs in Walther's patent, to wit, on page 4, line 32, "A is the close vessel before mentioned, wherein the oils, fats, and tallows are to be enclosed. In order to undergo the operation it must be of a sufficient strength to endure a pressure of five or six atmospheres without any danger of bursting;" on page 13, line 2, "But as the improvement of the purification of oil in this way is a matter of degree, the operation may be stopped short of the utmost degree of purification which can be obtained by the present improvements, according to the desire of the operator to occupy less time in the occupation, or may be carried on to the full extent, according to his desire to effect the greatest purification that can be attained by the present improvements;" on line 13, page 13, "Or, on the other hand, if impurities are more fixed in the oil, then, by increasing the pressure, (suppose another atmosphere, that is, to five atmospheres,") &c., I ask you whether, in your opinion, the patent contemplates no greater pressure than five atmospheres?

A. I think the highest pressure it contemplates for purifying oils is the special case in which "impurities are more fixed in the oil," in which he supposes an additional atmosphere, say sixty pounds pressure, (which I interpret his expression "five atmospheres" to mean,) will effect "a still greater purification." It does not, I think, contemplate any higher than sixty pounds pressure for any other purpose.

Re-examination:

Q. 473. As far as you know, are oils or liquid fatty bodies improved in value or usefulness in the arts by being decomposed into fat acids?

A. I am not aware of their being improved in value or usefulness by being so decomposed.

Q. 474. Are they not injured for the purposes of burning in lamps and lubrication of machinery by being decomposed into fat acids?

477 (Objected to as embracing a subject-matter not referred to in any part of the cross-examination, and therefore not properly inquirable into now.)

A. They are.

Q. 475. Calling your attention to the use of "very dilute sulphuric acid," in Hirschfeld's first process, as described in Exhibit 20, would not this sulphuric acid tend to have the same effect of commencing a decomposition of the fat as the sulphuric acid used in Hirschfeld's second process?

A. It would.

Q. 476. If, then, only "purified" tallow is produced in Hirschfeld's first process, as described in the exhibit, would it or would it not prove

that no appreciable amount of decomposition of the fat was effected by the water used in said process even after a decomposition had been or might have been commenced by the sulphuric acid in said first process?

A. It would prove that no appreciable amount of decomposition had been effected.

Q. 477. The temperature, pressure, and time employed, being the same in the second as in the first process, as described in the exhibit, and the decomposition having been commenced in both processes by the sulphuric acid, it would follow, would it not, that the water at a high temperature and pressure would not effect any more decomposition in the second than in the first process?

A. It would necessarily follow.

Q. 478. The decomposing effect of the water on the fat being inappreciable in the first process, it would follow, would it not, that its decomposing effect in the second process would also be inappreciable, the temperature, pressure, and time being the same in both processes, and the decomposition having been commenced in both by the sulphuric acid?

A. It would necessarily follow.

Q. 479. Examine Wilson's process of rendering or melting fats, described in Morfitt's Chemistry of Soap and Candles, Philadelphia, 1847, pages 339 to 343, and same work, second edition, Philadelphia, 1856, pages 321 to 324, and explain said process.

(Question objected to as involving new matter not touched upon in cross-examination, and inasmuch as said alleged Wilson's process is not referred to in defendants' answers or exhibits, and inasmuch as such question is equivalent to opening anew this examination.)

478 A. It is a process for rendering the raw material for candles or tallow in a close iron vessel, by steam from an ordinary boiler, at a pressure of from 50 to 100 pounds, some of the steam condensing into liquid water during the operation, which lasts from ten to fifteen hours; and, "after sufficient repose, the fatty matter separates entirely from water and foreign admixture, and forms the upper stratum."

Q. 480. What is the fatty product of Wilson's process described to be?

A. Rendered tallow or lard.

Q. 481. Is any fat acid or glycerine described or mentioned to be produced in Wilson's process?

A. Neither.

Q. 482. How does Wilson's process, as described, resemble the processes described in the defendant's exhibits, No. 7, 13, 14, 15, 16, 17, and 20?

A. It resembles them in rendering, melting, or purifying tallow or fat, by heating them with steam or water, or both, at a high temperature and pressure, except No. 13, which does not express such high temperature and pressure.

Q. 483. If the product of Wilson's process is what is practically and commercially known and used in the arts as neutral fats, would the product of the processes described in said exhibits be also what is practically known and used as neutral fat, or would it be something different; and if so, what?

A. It would be the same.

Q. 484. If the product of Wilson's process is what is practically known and used in the arts as neutral fat, must not the amount of de-

composition of said fat into fat acids by the action of water at a high temperature and pressure, during said process, have been so slight as to be practically insignificant and inappreciable?

A. It must have been practically insignificant and inappreciable.

Q. 485. If the amount of decomposition of the fat into fat acids in Wilson's process is practically inappreciable, must not the amount of decomposition of the fat into fat acids in the processes described in said exhibits be also practically inappreciable?

A. It must have been practically inappreciable in the processes as described in said exhibits.

Q. 486. Does the fact that in all said exhibits the products are called "tallow," or "fat," or "oil," confirm and corroborate the idea that the said products were what are practically known and used in the arts as neutral fats?

479 A. It confirms the idea that they were practically neutral fats.

Q. 487. As a general fact, do or do not the fats and oils of commerce which are known and used in the arts as neutral fats, contain small proportions of free fat acids?

A. They do, as a general fact.

Q. 488. If so, does not this prove that they have been decomposed to a slight extent, either in their original preparation or become so by keeping?

A. It does.

Q. 489. How many atmospheres, according to the German and French method of computation, does the pressure mentioned in Wilson's process amount to?

A. Fifty pounds pressure is equal to $4\frac{1}{3}$ atmospheres, and one hundred pounds pressure is equal to $7\frac{2}{3}$ atmospheres.

Q. 490. What is the date of the invention of Papin's digester?

A. 1681, as stated in Dictionnaire de l'Industrie, vol. 5, Paris, 1836, page 567.

Q. 491. Were your answers given in your examination-in-chief the deliberate expressions of your scientific opinions, derived from experiment and research, or were they in any way influenced by the complainant, or his counsel, or any other person?

A. They were the deliberate expressions of my scientific opinions, derived from experiment, observation, and research, and were in no way influenced by any person whatsoever.

Cross-examination resumed:

X Q. 492. What, if any, preliminary treatment do the fats of commerce undergo before they become such articles of commerce?

A. They are rendered from the raw fats.

X Q. 493. If the word tallow is employed, do you understand that it is raw suet or commercial tallow?

A. Sometimes it refers to raw suet, and sometimes to fat after the first rendering.

X Q 494. If commercial tallow was submitted to the process described in Morfitt's work, edition of 1847, referred to as Wilson's process by you, what do you think would be the resulting products of such process?

A. "Fatty matter," "water, and foreign admixture," separated from each other.

X Q. 495. Would such fatty matter be decomposed fatty matter?

A. I do not think it would be.

480 X Q. 496. Taking the paragraph on page 341 of said work,

commencing with the words, "Mr. Wilson told me he had ascertained by actual experiment that to produce the best result the steam pressure should not be less than fifty pounds to the inch, though the weight used by him was seventy-five pounds, and that he intended to carry it to one hundred pounds, as by that means the rapidity of the process would be augmented." In a preceding sentence, on said page, the following language occurs: "After ten or fifteen hours' continued ebullition the steam is stopped off." If such was Wilson's process, commercial tallow being the subject of treatment, what do you think were the products of such treatment?

(Complainant's counsel objects that the form of the question implies that the same operation is spoken of throughout, whereas it appears from the book quoted that the process in which ten or fifteen hours was employed was operated "at the requisite pressure," without further specifying what such pressure was. The reference in the question to the pressure of fifty to seventy-five and one hundred pounds is to the verbal expressions of Mr. Wilson, and not to any operations described.)

(To the objection thus made by complainant's counsel, the defendants' counsel replies by referring complainant's counsel to his own examination of the witness, in which, Question 489, he asks the witness, "How many atmospheres, according to the German and French method of computation, does the pressure mentioned in Wilson's process amount to?" to which the witness answered, "Fifty pounds pressure is equal to $4\frac{1}{3}$ atmospheres, and 100 pounds pressure is equal to $7\frac{2}{3}$ atmospheres.")

A. If such were Wilson's process the product would be a purer tallow and impure residues.

X Q. 497. What would be the temperatures corresponding to such pressures respectively?

A. Fifty pounds pressure would be about 298° Fa'r., and one hundred pounds pressure about 338° Fa'r.

X Q. 498. And you think, do you, that tallow, filling the vessel "to within about two and a half feet of the top," could be submitted to the action of steam at the temperature and pressures stated above for "ten or fifteen hours" without decomposition?

(Complainant's counsel objects that the question implies that both the maximum time and maximum pressure mentioned in the book
481 may be used simultaneously, whereas it expressly states that when one hundred pounds pressure was to be used the rapidity of the process will be augmented.)

A. I know that the chief object of the high steam is to separate the fat proper from the matters with which it is associated in the cruder tallow, from the statements made in the description of Wilson's process in the work referred to. Whether any decomposition of the fat proper, as distinguished from its impure associates, takes place, I certainly cannot say from the description of the process, or its product, nor from any reasoning of my own.

Examination adjourned to to-morrow (Saturday) morning at 9½ o'clock.

SATURDAY, *March 6th*, 9½ *a. m.*

Present, B. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

Recross examination resumed:

X Q. 499. Understanding that the word "tallow," in the last question, refers to commercial tallow, and not rough tallow or suet, will you please

give your opinion as to the resulting products from its treatment as stated in X Q. 498?

A. My opinion is that the first action of the steam is as stated in preceding answer, but that its further action would be under the conditions enunciated in the X Q. 498, to resolve more or less of the fat proper into free fat acids and glycerine.

X Q. 500. Look at the context in Morfitt's work, 1847, and state what materials were submitted for treatment in Wilson's process as therein described; and your attention is directed to page 326, line 2d, and to page 341, line 3d from the bottom of said page; and will you state whether such materials were not fat "enveloped in membranes and enclosed in cellular tissues, called rough tallow or suet," and whether also "the whole carcase of the hog, excepting the hams and shoulders," are not the materials which were submitted to such treatment?

A. The passage cited from page 326 is a definition of "rough tallow or suet," which is constituted as stated in the question. In the context of passage cited on page 341, in my opinion there are two processes referred to, one "making lard" from the balance of carcase of hog, as stated in question, the other "rendering tallow." Therefore while the definition on page 326 might refer to "the whole carcase," &c.,
482 the "rendering tallow," in context of page 341, appears clearly to refer to a previously rendered tallow, being contrasted in the same sentence with "whole carcase."

X Q. 501. What is the object of "rendering tallow?"

A. Freeing it from impurities, more or less, such as membrane, &c.

X Q. 502. And if Wilson's process, as described in Morfitt, 1847, contemplates the treatment of tallow which has already been rendered, do you not think that the treatment of such previously rendered tallow for the longest time and at the highest temperature and pressure stated on page 341 of Morfitt's work, 1847, to wit, for ten or fifteen hours, and at a pressure of one hundred pounds, would produce decomposition of such previously rendered tallow? I ask for your own present opinion, based upon your knowledge and research in this branch of science.

A. My opinion, based upon my knowledge of Mr. Tilghman's process, is that, under the conditions stated in the question, more or less of the rendered tallow would be converted into free fat acid and solution of glycerine.

(The defendants' counsel now gives notice to complainant and his counsel that he will, at the hearing of this cause, offer in evidence to the court the process as described in Morfitt's work, entitled Chemistry Applied to the Manufacture of Soap and Candles, by Campbell Morfitt, edition of 1847, published by Carey & Hart, Philadelphia, referring to drawing on page 339, and to text pages 340 and 341, as showing previous knowledge and use of the process claimed by the complainant in his said letters-patent.)

Redirect examination:

Q. 502. Can the existence of small proportions or quantities of free fat acid in the fats and oils of commerce, known as neutral fats and oils, be detected by ordinary inspection, or does it require a chemical testing to detect them?

A. I know of no way of recognizing their presence but by chemical tests.

Q. 503. Is not a large surface of contact of the fat and water, in proportion to the mass treated, an important element in producing in a given time the decomposition of fat into fat acids and glycerine by the action of water at a high temperature and pressure?

A. It certainly is an important element.

Q. 504. In Wilson's process is the rendering or melting out of the pure or commercial tallow or lard from the rough fat or suet gradual and progressive, or does it all take place at once?

483 A. I infer, on general chemical principles, that it must be gradual and successive; that it cannot take place all at once.

Q. 505. Drawing your attention to that portion of the fat or tallow first melted out from the raw suet in Wilson's process, would it not be exposed in a pure state to the decomposing action of the steam or water during the whole balance of the time of the operation?

A. It would.

JA'S C. BOOTH.

Sworn February 15th, and subscribed before me this 6th day of March, A. D. 1869.

W'M B. DAYTON,
Notary Public and Special Examiner.

Examination adjourned to Tuesday, March 16th, 10 a. m.

TUESDAY, *March* 16, 10 *a. m.*

Present, Benj. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

ROBERT E. ROGERS, being produced as a witness on behalf of complainant, and being by me duly cautioned and sworn, deposes and says:

Q. 1. Please state your name, residence, and occupation.

A. Robert E. Rogers; Philadelphia; professor of chemistry in the University of Pennsylvania.

Q. 2. State in what public institutions of learning you have held positions, and for how long. State what chemical works you have published or edited.

A. I was professor in the University of Virginia for over ten years; have been professor in the University of Pennsylvania for over fourteen years; have edited the last American edition of Turner's Chemistry; likewise the American edition of the English translation of Lehman's Physiological Chemistry.

Q. 3. Have you read and do you understand the letters-patent of the United States granted to complainant, No. 11766?

A. I have read and do understand it.

Q. 4. Have you read and do you understand the answer of the defendants, filed the first of August, 1868, and their supplementary

484 answer filed the first of December, 1868, as contained in the agreed printed copy now shown you?

A. I have read and I understand them.

Q. 5. Explain the two processes used by defendants in the manufacture of fat acids and glycerine as described in their said answers, and state wherein said two processes are substantially the same or different from each other in principle and operation.

A. The process described in defendants' first answer is to put water, fat, and a quantity of lime equal to seven per cent. of the fat, and some sand into a close vessel, and to heat them to about seventy-five pounds pressure by means of superheated steam. The product is described as "acid lime-soap," which is to be afterwards boiled with a quantity of sulphuric acid equivalent to the lime used, and the fat acids are thus said to be set free. The process described in defendants' supplementary

answer is to put water, fat, and a quantity of lime equal to four per cent. of the fat into a close vessel, and to heat them to about eighty-five pounds pressure by means of superheated steam. This product is also called "acid lime-soap," and is to be decomposed by a quantity of sulphuric acid equivalent to the lime used. The sand used in the first process is entirely inert, and has no chemical action or effect whatever. The two processes are essentially the same in their principle and operation, the only difference being in a change in the quantity of lime used from seven to four per cent., and an increase of the pressure by ten pounds per square inch. The chemical actions which take place are the same in both processes, and the products will be similar, that one which contains least lime being proportionally more acid, or containing a larger proportion of free fat acid, than the other.

Q. 6. State whether the processes of defendants as set forth in their said answers are substantially the same or different in principle and operation from that described and claimed in complainant's patent. If defendants' processes resemble complainant's in part only, state particularly how and in what part.

A. Defendants' products, which they call "acid lime-soap," are in reality mechanical mixtures of neutral lime-soap and free fat acids. The neutral-lime-soap portion is produced by the chemical action of the lime upon an equivalent quantity of fat. As to this portion of their products, the processes of defendants do not resemble complainant's process. But the quantity of lime used (seven to four per cent.) is not sufficient to combine with all the fat, but only, in round numbers, with about
485 seven-tenths to four-tenths, respectively, of the fat present; consequently there remains from three-tenths to six-tenths of the fat unchanged by and uncombined with the lime. The free-fat-acid portion of defendants' products is produced by the chemical action of water at a high temperature and pressure upon the latter portions of the fat. As to this part of their products, defendants' processes are identical in their principle and operation with that patented by the complainant. It follows that the smaller the quantity of lime used by the defendants the smaller is the proportion of their products, which is due to the chemical action of the lime, and the larger is the proportion which is due to the chemical action of the water at a high temperature and pressure.

Q. 7. Were you examined as a witness in the suit of R. A. Tilghman against Mr. Werk, in the circuit court U. S. for the southern district of Ohio, in 1860, and have you read, and do you understand, the answer filed by said Werk in said suit on the 6th of January, 1860, and the process of manufacturing fat acids and glycerine used by said Werk, as described in said answer?

A. I was examined in that suit; I have read and understand the answer filed, and understand the process used by Mr. Werk, as there described.

Q. 8. Explain wherein the processes used by the defendants in the present suit, as described in their answers, are in principle and operation substantially the same or different from that used by Mr. Werk in 1860.

(Question objected to by counsel for defendants for the reason that the same is irrelevant, inasmuch as these defendants are not bound or concluded by said suit.)

A. The processes used by the present defendants are precisely the same in principle and operation as that used by Mr. Werk in 1860. In all these processes fat, water, and lime are used, the lime being in quantity sufficient to combine with only a part of the fat. They are heated

together in close vessels to a high temperature and pressure by superheated steam. In all of them the chemical action of the lime upon one part of the fat produces an equivalent quantity of lime-soap, and the chemical action of the water at a high temperature and pressure upon the remainder of the fat produces free fat acids. In all of them the product is what defendants call an acid lime-soap, (a misnomer,) which is in fact a mixture of neutral lime-soap and free fat acids. The processes differ only in the proportion of lime used, and the degrees of heat and
486 pressure employed, which are merely matters of detail, not affecting the essential features of the operations, which are identical.

Q. 9. Did you analyze a sample of Mr. Werk's product in 1860? If so, give your analysis thereof; give also a calculation of the proportions of lime-soap and free fat acid in said product, separate from the glycerine and water.

(Objected to as to previous question.)

A. I did analyze a sample of Mr. Werk's product in 1860. My analysis gave

Fat acids	29.27
Glycerine	2.41
Lime-soap	41.10
Water	25.97

The lime-soap referred to yielded of lime 9 and 4-10 per cent. Calculated separate from the glycerine and water, the proportions of fat acids and lime-soap would be

Fat acid	41.60
Lime-soap	58.40
	100

Q. 10. State whether you have made a chemical examination of an alleged product of the process of the present defendants, and if so, when and where, and what you found said product to consist of.

A. I saw an alleged sample of defendants' product at Professor Booth's laboratory, in Philadelphia, some months ago. I made a chemical examination of it so far as to ascertain its nature, but I did not make a quantitative analysis of the same. By mixing it with solvents, such as cold alcohol, ether, benzine, wood-spirit, light coal-oil, or sulphuret of carbon, a white powder settled to the bottom, and the solution became acid, and when evaporated left a substance having all the properties of fat acids. The white powder which settled had all the properties of neutral lime-soap. The original product consisted of a mixture of neutral lime-soap and free fat acids.

Q. 11. State whether you ascertained the methods used for the quantitative analysis of said product, in Professor Booth's laboratory, and examined the results thereof; and whether in your opinion those methods and results are correct.

A. I examined the methods of analysis used, and saw the results produced, and am satisfied that they are correct.

487 Q. 12. How do the results of Professor Booth's analysis of defendants' product agree with the alleged constitution of said product, as described in defendants' answer, and how do they compare with your own analysis of Mr. Werk's product in 1860.

A. Allowing for the impurities always existing in commercial lime, the results of Professor Booth's analysis agree closely with the composition of the product as stated in the answer. As compared with my own

analysis in 1860, the present product shows a considerable increase in the proportion of free fat acid present, being 58 per cent. in the 1868 product against 41½ per cent. in the 1860 product, and a corresponding diminution in the proportion of neutral lime-soap present, (42 per cent. in the 1868 product against 58½ per cent. in the 1860 product.) This difference corresponds with the change made in the proportion of lime used, six per cent. in 1860, and four per cent. in 1868.

Q. 13. Did you see the results of any mechanical treatment of defendants' product in Professor Booth's laboratory—if so, describe the same?

A. Defendants' product is a soft, white, greasy substance like tallow. When squeezed between unsized paper it gives an oily stain to the paper, and when this is repeated several times, the residue becomes gradually more hard and dry. A quantity of defendants' product was thus repeatedly squeezed between papers, at first cold and then hot, until no more greasy stain was imparted to the paper; the substance left was a dry, white powder, entirely free from any greasy feel. I saw the results of this analysis in Professor Booth's laboratory by approved methods, and its composition was that of neutral lime-soap. I also saw the results of the treatment of the greasy papers by hot alcohol, and the substance absorbed by the papers was shown to be free fat acid, holding in solution a small quantity of neutral lime-soap. Simple mechanical squeezing, therefore, separates free fat acid from the neutral lime-soap, which are thus to my mind proved to exist mixed together in defendants' product.

Q. 14. The defendants allege in their answer that their product does not contain any free fat acids, but is a different substance which they call "acid lime-soap." State whether the results of the chemical and mechanical treatment of defendants' product prove or disprove this allegation, and give your reasons.

A. The treatment with alcohol, ether, or one of the neutral substances above named, is the method uniformly used by chemists
488 to separate fat acids from other substances insoluble in these liquids. As this treatment separates defendants' product into two substances, one of which has the composition and all the properties of neutral lime-soap, and the other all the properties of free fat acids, we are forced to the conclusion that the product in question is a mixture of these two substances. In addition to this, we find that simple mechanical pressing, without any chemical treatment whatever, will separate defendants' product into these two identical substances. The conclusion is irresistible that it is a mechanical mixture of these substances. Besides, there is no such substance as "acid lime-soap" known or recognized to exist by chemists. Only one lime-soap, consisting of one equivalent or 28 parts of lime to one equivalent or 275 parts of fat acids, (stearic,) forming a neutral lime-soap, is known, and its properties and constitution are described in standard chemical treatises; and one of the two substances separated by the chemical solvents, or by mechanical pressing, from the defendants' product has precisely this constitution and these properties. To assume the defendants' products made at one time with six per cent. lime, at another time with seven per cent., at another time with four per cent., were all "acid lime-soaps," or in other words, were chemical combinations of fat acids with these varying quantities of lime, would be to contradict the law of definite proportions, which is universally recognized as the basis of the science of chemistry.

Q. 15. State whether or not the chemical agent in producing the 58 per cent. of free fat acid found in defendants' product is water at a high temperature and pressure?

(Objected to as being leading.)

A. The chemical agent producing the effect is water at a high temperature and pressure.

Q. 16. So far as the production of this fat acid in defendants' product is concerned, does it make any difference whether the mixture of fat and water is heated by a fire, or by superheated steam, or by any other heating agent?

A. It makes no difference whatever.

Q. 17. Has the superheated steam used by defendants any other effect than that of heating and mixing the materials in the digester?

A. It has no other effect.

Q. 18. Explain what happens when superheated steam comes in contact with water less highly heated than itself.

A. Superheated steam will give off its surplus heat to the water
489 and be converted into common steam. This common steam will then either escape in the form of steam, or it may be condensed into liquid water, according to the temperature and pressure of the water with which it is in contact.

Q. 19. Explain the method of formation of the glycerine in defendants' processes, and the chemical actions which produce it.

A. Part of defendants' fat, say four-tenths, being decomposed by the lime, the glycerine belonging to that portion is separated by the chemical action of the lime. The remaining six-tenths of the fat being decomposed by water, the glycerine of that portion is separated by the chemical action of the water at a high temperature and pressure. In round numbers, about four-tenths of the glycerine is due to the action of the lime, and six-tenths to the chemical action of the water at high temperature and pressure.

Q. 20. In defendants' digester, which of the two portions of his product is formed first, the lime-soap portion, or the free-fat-acid portion, and give your reasons?

A. The lime-soap portion is necessarily formed first. Lime is a much stronger chemical agent than water, and will decompose fat at and below 212° Fa'r., whereas water has scarcely a perceptible chemical action on fat until the heat has risen considerably above 212° Fa'r. As long as any free or uncombined lime is present in the mixture, no fat acid can possibly exist in a free or uncombined state, because the lime would instantly combine with it. Therefore, until all the lime present has taken up its full dose or equivalent of fat acid, the formation of the free-fat-acid portion of defendants' product cannot begin. After the lime has become fully saturated, and formed the lime-soap portion of the product, and as soon as the temperature and pressure have become sufficiently high, the chemical action of the water begins to decompose the remainder of the fat, and forms the free-fat-acid portion of defendants' product.

Q. 21. How would you designate or identify these two successive stages of defendants' process?

A. The lime-soap portion of defendants' product is made by the lime-saponification process, in close vessels, as described by Milly and Motard, in Defendants' Exhibit 5, in this case. The free-fat-acid portion of their product is made by Tilghman's process of decomposition by water at a high temperature and pressure.

Q. 22. As compared with the processes of manufacturing fat acids,
commonly employed prior to Tilghman's patent, by using
490 about fourteen pounds of lime and thirty-six pounds of sulphuric acid to the 100 pounds of fat, does or does not the process pat-

analysis in 1860, the present product shows a considerable increase in the proportion of free fat acid present, being 58 per cent. in the 1868 product against 41½ per cent. in the 1860 product, and a corresponding diminution in the proportion of neutral lime-soap present, (42 per cent. in the 1868 product against 58½ per cent. in the 1860 product.) This difference corresponds with the change made in the proportion of lime used, six per cent. in 1860, and four per cent. in 1868.

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A. Superheated steam will give off its surplus heat to the water
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Q. 21. How would you designate or identify these two successive stages of defendants' process?

A. The lime-soap portion of defendants' product is made by the lime-saponification process, in close vessels, as described by Milly and Motard, in Defendants' Exhibit 5, in this case. The free-fat-acid portion of their product is made by Tilghman's process of decomposition by water at a high temperature and pressure.

Q. 22. As compared with the processes of manufacturing fat acids, commonly employed prior to Tilghman's patent, by using
490 about fourteen pounds of lime and thirty-six pounds of sulphuric acid to the 100 pounds of fat, does or does not the process pat-

ented by Mr. Tilghman show a reduction in the quantity of lime to be employed to zero or a small comparative amount?

(Question objected to as assuming that the processes commonly employed anterior to the complainant's patent were such as is stated in the question.)

A. It does.

Q. 23. Does or does not the said process of Tilghman show a reduction in the quantity of lime?

(Same objection as to preceding question.)

A. It does.

Q. 24. In the said process of Tilghman, is or is not this reduction in the amount of lime and sulphuric acid due to the employment of the chemical power of highly-heated water?

A. It is.

Q. 25. As compared with the old process of using 14 pounds of lime and thirty-six pounds of sulphuric acid to the 100 pounds of fat, does or does not the process of the defendants show a reduction in the quantity of the lime and sulphuric acid employed?

(Same objection as to preceding question.)

A. It does.

Q. 26. Is or is not this reduction of the quantity of lime and sulphuric acid in defendants' process due to the fact that the chemical power of highly-heated water is employed?

A. The reduction is due to the chemical power of highly-heated water employed in defendants' process.

Q. 27. Is or is not the action of the chemical power of highly-heated water in defendants' process and in Tilghman's process the same?

A. It is identically the same.

Q. 28. Is or is not the employment of this chemical power of highly-heated water the characteristic feature of Tilghman's process as patented?

(Objected to, the construction of said patent being matter of law for the court.)

A. It is.

Q. 29. From your knowledge of chemistry, who should you say was the discoverer of the chemical power of water in a liquid state, at a high temperature, on fats, to produce fat acids and glycerine?

491 (Objected to as an improper method of examining the witness, and as calling for negative testimony.)

A. From my knowledge of chemistry, and from reading, my conviction is that Mr. Richard Tilghman is the discoverer of the chemical power of water in a liquid state, at a high temperature, on fats, to produce fat acids and glycerine.

Q. 30. Do you know of any other person who has claimed the merit of this discovery?

(Question objected to for same reason as to preceding question.)

A. I do not.

Q. 31. Is or is not this discovery regarded as a new and important fact in chemistry?

(Objected to as to last question.)

A. It is.

Q. 32. Were you present at any trial of the process of complainant in the coil-apparatus described in his patent? If so, state who was present, and whether or not in your opinion said apparatus is a practical one for carrying on said process of complainant.

A. I was present at a trial of the process referred to in the question,

in company with Professor James C. Booth, Dr. Robert Bridges, and Mr. R. A. Tilghman. It is my opinion—and not only my opinion, but my thorough conviction—that it is a process altogether adapted to carrying out the method of Mr. Tilghman.

Q. 33. Was the value of the fat acid and solution of glycerine produced thereby impaired by the presence of acroleine; and, if so, to what extent?

A. The odor of the products evinced nothing offensive, which would indicate the presence of acroleine as a hurtful substance, the small amount of oxide of iron being an accidental, and not necessarily present substance, and was readily removable.

Q. 34. How could this discoloration of the fatty acids by iron be prevented in using said process? State, also, whether if the fat acids produced were to be subsequently purified by distillation, this discoloration from iron would be in any way objectionable.

A. The total absence of the oxide of iron would be secured by either constructing the coil of metallic copper, or by lining the iron tube with a tube of copper. Distillation of the fat acids would yield the acids themselves pure, while the oxide of iron, not being volatile, would be left behind in the distilling apparatus, and therefore the primary discoloration of the products would not interfere with the ultimate purity of the fat acids.

492 Q. 35. Can you state whether distillation of dark-colored fat acids is practically employed on a large scale to purify them for the manufacture of candles, and whether they produce white products by such distillation? State, also, how the degree of discoloration of the crude product of the coil-apparatus compares with the color of the fat acids so submitted to distillation.

A. The distillation of colored fat acids is, to my knowledge, practically pursued, I having, under the guidance of a large manufacturer of candle-stock in Philadelphia, witnessed the processes severally in progress of the treatment of the original crude fat with sulphuric acid, the subsequent washing, and then distillation of the blackened fat-acid mixture, which was to yield, by pressure, the solid and the liquid fat acids. The material introduced into the distilling-apparatus was far darker, more unsightly, and indicative of impurity than any of the product which I saw come over from Mr. Tilghman's apparatus during an operation of at least an hour and a half. The cooled mass, the product of distillation, was nearly white. When ground and subjected to hydraulic pressure, it furnished the solid fat acids of beautiful white and pearly appearance.

Q. 36. Can you state, of your own knowledge, whether or not acroleine was disengaged during the progress of said manufacture; and, if so, how it compared with the quantity, if any, envolved in working complainant's coil-apparatus? I speak, now, not of the absolute gross amount of acroleine disengaged in the two processes, but the relative offensiveness of the same quantity of liquid obtained from each.

A. Acroleine was disengaged in an enormous quantity during the said process. It was recognized as pervading the establishment upon entering the counting-house. It became more offensive and oppressive the nearer I approached the distilling arrangements, and was evolved from them in such volumes as that the special precaution of a brick chamber was required for their reception and confinement, to render the place at all tolerable to the operatives engaged—even with the precaution of a close door kept shut, of this apartment, and passing the vapor under the boiler that it might be consumed—a constant sense of irrita-

tion was experienced by its presence. While in the case of Mr. Tilghman's process, which I witnessed, at no time did I perceive, in the small apartment where the process was conducted, any odor of acroleine at large, and only recognized the faintest indication of it when the
493 nose was placed immediately over the fresh products, as they escaped by the safety-valve. The quantities of acroleine produced in the two cases, I conceive, are not to be compared with each other—the one the merest trace, the other in volumes that could be collected.

Q. 37. Was the stearic acid or candles themselves produced by said process (of sulphuric acidification and subsequent distillation) contaminated and injured by the smell of acroleine, so strongly disengaged during their manufacture?

A. I brought away with me a specimen of the distilled product from the factory, before it was pressed, and a product after pressure, both of which were free from acroleine odor after they were carried away from the establishment, where the odor prevailed generally.

Q. 38. Examine Defendants' Exhibits Nos. 1, 2, 3, and 19, and state whether they contain any evidence of a prior knowledge or use of the process patented to the complainant.

A. They do not.

Q. 39. Explain, in detail, what facts are announced in said Exhibits Nos. 1, 2, 3, and 19.

A. Exhibit 19 contains a description of Perkins' steam-generator, wherein water is heated to a high temperature and pressure. It is a strong vessel, provided with a feed-pump, a loaded safety-valve, and a steam-pipe, leading to an ordinary steam-engine cylinder. It is directed to be kept full of highly-heated water, and when the pump forces in a quantity of cold water, the loaded valve is forced open and permits the escape of an equal quantity of the highly-heated water, which "flashes immediately into steam," and rushes into the cylinder and works the piston. The steam, after doing this work, is condensed in a separate reservoir, and the water thus resulting is pumped back into the generator. Exhibits 1, 2, and 3 have the title "Change of fat in Perkins' engine by water, heat, and pressure." They state that a mixture of oil and tallow was used to lubricate the piston of Perkins' engine, and was thus exposed to the action of steam at a considerable pressure and temperature. In the account alleged to be given by Faraday of an examination of the product, the following points were stated: The original mixture melted at 85° Fa'r., was slightly soluble in boiling alcohol. The product obtained from the surface of the condensed water was a black scum, sometimes soft, but after long exposure to the action of the steam, hard like wax nearly. It dissolved completely in hot alco-
494 hol, leaving only dirt and mechanical impurities. The hot alcoholic solution on cooling let fall flocks, which, when dried and melted, gave a gray substance like wax, which would not melt in boiling water, but melts at a higher heat and burns, leaving an ash, consisting, principally, of carbonate of lime. It dissolved readily in alkalies and in alcohol. It did not dissolve in ether, or very slightly. The cold alcoholic solution left a similar substance, but softer. The merest trace of copper was found in these substances.

Examination adjourned to to-morrow (Wednesday) morning at 10 o'clock.

WEDNESDAY, *March* 17—10 *a. m.*

Present, B. C. Tilghman, esq., for complainant; Chas. B. Collier, esq., for defendants.

Examination further adjourned to to-morrow (Thursday) morning, at 10 o'clock.

THURSDAY, *March* 18—10 *a. m.*

Present, B. C. Tilghman, esq., for complainant; Chas. B. Collier, esq., for defendants.

Examination of Robert E. Rogers resumed.

Q. 40. Explain in detail wherein the process and results described in Exhibits 1, 2, 3, and 19, resemble or differ, in principle and operation, from the process and results described in complainant's patent.

A. The important point of difference is that in these exhibits it is nowhere stated that any fat acid or glycerine was produced. It is moreover certain, from the chemical properties described, that the product was not fat acids. Its resemblance to fat acids in two properties—solubility in alcohol and in alkalies—is noticed by Faraday. But these properties are possessed by other fatty substances, such as neutral fats and soaps, and therefore are resemblances and only resemblances, as the author calls them, and are not proofs of its identity with fat acids. The product differs from fat acids in three marked and distinctive characteristics, either one of which is sufficient to prove it to be a different chemical substance. Thus: 1st. The free fat acids are very soluble in ether. Faraday's product did not dissolve in ether, or very slightly. 2d. Fat acids melt at from 110° to 140°, according to whether they are pure stearic, or stearic acid mixed with oleic acid. Faraday's product would not melt in boiling water, 212° F. 3d. When burned, fat acids leave no ash, or the merest trace, if they have been prepared with
495 lime. Faraday's product, when burned, left an ash chiefly of carbonate of lime. It is, therefore, inconsistent with chemical reasoning—it is absurd—to infer that a substance having such unlike, even opposite properties, should be of the same chemical nature. With our present knowledge, especially that derived from Tilghman's patent, we can see that if fat and water alone, without any other substance to combine with the fat acid, had been exposed to a heat and pressure in Perkins' generator, there would have been a formation of fat acid and glycerine. It is made certain, by the statements of Faraday, that lime, in unknown quantity, was also present, and must have been brought in contact with the water and fat, and that it combined with the fat acid of the fat, and formed a substance altogether different from a free fat acid. Had no lime been present, it is probable that the fat acid might have been recognized and announced as such, in which case Tilghman's discovery would have been anticipated by thirty years. As the facts exist, it is perfectly clear that neither Faraday nor any other chemist, from the year 1823 to 1854, regarded or announced the product described in the exhibits to be fat acids; and consequentiy the decomposition of fats into fat acids and glycerine, by the action of water at a high temperature and pressure, remained unknown until Tilghman's patent.

Q. 41. Is the chemical fact which forms the basis of complainant's process as patented, an interesting and important one; and would its first publication be likely to attract attention, and to be copied into chemical treatises? State what publications you have examined on the subject, and with what result?

A. Such a decomposition and conversion is undoubtedly a most interesting and important chemical fact, both scientifically and in its practical application to an extensive and useful manufacture; and any clear

and distinct announcement of it, especially from such authority as Faraday, could not have failed to attract attention, and to have been copied into the chemical and technical treatises of the period. I have examined the chemical and technical works mentioned by Professor Booth in answer to questions 68, 69, and 70 of his direct examination in this case, and find that, in those of dates earlier than 1854, there is no mention of or reference to this fact, while all those of dates later than 1854 do mention or refer to it. All the treatises referred to by Professor Booth are standard works of the highest authority in their respective lines.

Q. 42. Would a chemist or manufacturer possessed of ordinary
496 skill and information on the subject, as current prior to 1854, if he should read Defendants' Exhibits 1, 2, 3, and 19, have thereby become acquainted with the chemical fact that fat can be decomposed into fat acid and glycerine by the action of water at a high temperature and pressure?

(Objected to for the reason that the witness is not a manufacturer, and for the further reason that, while the witness may be called upon to testify as to what information he himself would have derived from the exhibits, he cannot testify as to what others than himself would have learned therefrom.)

A. It is my opinion that he would not. Faraday did not so consider it or he would have undoubtedly announced it as a fat acid. He only states certain properties, some of which suggest to his mind a resemblance to fat acids, but nowhere states the product to be fat acids. It is my belief that he was too well informed upon the matter of the manufacture or soaps and fat acids to have omitted or failed to suggest the value and practical application of so important a discovery. He does not announce it as a discovery of fat acid, but speaks of it merely as showing two points of resemblance to the fat acids of Chevreul. The Exhibit 1 might have suggested to him, and to other chemists, the making of further experiments on the subject, and had they been made might have led to the discovery. But, from all that I have read, no such were at that period made, and such a discovery is not contained in Faraday's announcement.

Q. 43. Judging from all the properties of the substance as described in Exhibit 1, what do you infer it to have been?

A. I infer it to have been a neutral lime-soap.

Q. 44. Have you made a chemical examination of the neutral lime-soap made from a mixture of equal parts of oil and tallow? If so, state how said lime-soap was prepared and what its properties are, as compared with those of the substance described in Exhibit 1.

A. I saw in Professor Booth's laboratory a neutral lime-soap, prepared by heating a mixture of equal parts of olive-oil and tallow with thirteen per cent. of lime and water in a close copper vessel, at a temperature between the melting point of tin and bismuth. It was a harsh and brittle substance of a grayish color. It was dissolved by digesting in alcohol, and the clear solution poured off while hot, on cooling de-
posited a white powder, which, when collected and fused, formed
497 a hard substance having a resemblance to wax, but more brittle and resinous. It was lighter than water. It did not dissolve in hot ether. It did not melt in boiling water at 212°, but at a higher temperature it melted and finally burned like fat, leaving a residue of carbonate of lime. On boiling with alkali it dissolved, giving a turbid solution, and, on making a direct comparative trial, it was found to dissolve in the alkaline solution more readily than neutral fat. The white

powder which precipitated from the hot alcoholic solution, by cooling, was a stearate of lime, which is somewhat soluble in hot alcohol, but nearly insoluble in cold alcohol. The fluid substance obtained by evaporating the cold alcoholic solution was an oleate of lime, which is somewhat more soluble in cold alcohol. The neutral lime-soap which I examined, therefore, agrees substantially with the substance whose properties are described by Faraday in Exhibit 1. As we know positively that the substance in Exhibit 1 contained lime as well as fat, and as its properties described agree so entirely with those of neutral lime soap, I infer that it was neutral lime-soap.

Q. 45. Did you burn the fluid substance obtained by evaporating the cold alcoholic solution, (which you call oleate of lime;) and, if so, did you obtain any ash, and of what nature?

A. I did burn a portion of that material, which left an ash; which ash was the carbonate of lime.

Q. 46. Examine Defendants' Exhibit 4, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant?

A. It contains no such evidence. It refers only to saponification of fats by lime in close vessels or boilers, and does not mention or refer to the production of fat acids by the action of water on fats at a high temperature and pressure.

Q. 47. Examine Defendants' Exhibit 5, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant?

A. It does not contain any such evidence. The first part of Exhibit 5 recommends thorough stirring of fat, lime, and water as advantageous for rapid and complete saponification, and suggests that possibly part of the lime commonly used in excess above theoretical requirement might thus be saved. Perfect and complete saturation by the lime is the leading idea insisted upon, and this is precisely the reverse of complainant's process, which produces free fat acids directly from the fat, and which cannot occur when the fat is combined with lime. The
498 second part of Exhibit 5 refers to the production of neutral lime-soap in close vessels at a high temperature and pressure. Lime in quantity "sufficient for the saponification of the fat" is distinctly directed to be used, and this absolutely excludes the possibility of those reactions which belong to complainant's process taking place, because the fat being all combined with the lime none remains for the highly-heated water to act upon.

Q. 48. Examine Defendants' Exhibit No. 6, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant?

A. It contains no such evidence. It refers exclusively to the making of soaps either in open or close vessels.

Q. 49. Examine Defendants' Exhibit No. 7, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant?

A. It does not contain any such evidence. It refers solely to the modes of melting tallow, either by steam or in a digester, which last is said to make it very hard. It does not in any way mention or refer to the making of fat acids or glycerine.

Q. 50. Examine Defendants' Exhibit No. 8, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant?

A. It does not contain any such evidence as will appear by reading

not only the fragment or mutilated extract which makes up the exhibit, but the whole description of the process for acidifying fats by sulphuric acid and water, and then distilling them by a current of steam. This process differs from Tilghman's in every particular. In it sulphuric acid is the chemical agent employed. In Tilghman's, water. In it the fat acids are distilled. In Tilghman's they are not distilled. In it open vessels and no pressure are used. In Tilghman's closed vessels and high pressure are necessary. In it no liquid water is mixed with the highly-heated fat. In Tilghman's it is necessary to have water mixed with the highly-heated fat. The latter part of Exhibit 8 refers to Dubrunfaut's process for making fat acids by distillation with superheated steam. I have read and understand Dubrunfaut's patent for this process. It is altogether different from Tilghman's. In Dubrunfaut's the fat acids are formed in the act of being distilled and converted into vapor, which is afterwards condensed. In Tilghman's the fat acids are not converted into vapor and condensed, but are formed as liquids, and always remain in the liquid state. In Du-
499 brunfaut's open vessels are necessary and closed vessels impossible. In Tilghman's closed vessels are necessary and open vessels impossible. In Dubrunfaut's the presence of liquid water mixed with the heated fat is impossible. In Tilghman's it is necessary. In Dubrunfaut's no pressure is used. In Tilghman's high pressure is necessary.

Q. 51. Examine Defendant's Exhibit 9, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant.

A. Exhibit 9 contains no evidence of such use or knowledge; it only states that some drops resembling glycerine had been found on top of some castor-oil kept two years exposed to the air at common temperature and pressure. None of the necessary conditions of complainant's process were present. There was no close vessel, no high temperature, no high pressure, no mixture of fat and water, and no mention of fat acid being produced. It is well known that the volatile compounds which give the peculiar smell and taste to natural oils and fats are liable to spontaneous change, whereby they set free their glycerine. The presence of some ferment or fermenting substance probably aided the action. At least this is the most natural and simple explanation of the fact. The possibility of such a change having so resulted is made manifest, first, by a paragraph in Dumas' Treatise on Chemistry applied to the Arts, vol. 6, Paris, 1843, page 569, wherein "these acids become free in consequence of a real fermentation under the influence of water and an animal substance acting as a ferment;" and paragraphs in Berzelius' Treatise on Chemistry, vol. 6, 1850, page 422 and page
500. 500.

Q. 52. Examine Defendants' Exhibit 10, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant?

A. I have read and understand Radley & Meyer's patent. It contains no evidence of a prior knowledge of Tilghman's process. The first part of the printed exhibit treats bones, offal, and lime in a close vessel at from 212° to 250°, so as to saponify the fat therein. The process is the same as that of Exhibits 4, 5, and 6, for making lime and other soaps under pressure. It does not mention or refer to the production of fat acids by the action of water at high temperature and pressure. The latter part, cap. 3, page 14, of official printed patent, describes the saponification of tallow with fourteen per cent. of

500 lime, or oil with seven per cent., in close vessels, at from 220° to 250°. It names the product as lime-soap, and refers to the decomposition of the latter by strong acids for obtaining the fat acid. It nowhere mentions or even hints at fat acid or "acid lime-soap" as being produced, but names the product more than forty times as soap.

Q. 53. Can you state from your own personal knowledge whether any free fat acid or so-called "acid lime-soap" will be formed in the digester when operating with oil, seven per cent. of lime, water, and sand, as directed in Radley & Meyer's patent?

A. Professor Booth and I made the experiment March 25th, 1868, following out in detail all the directions of Radley & Meyer, using oil, water, sand, and seven per cent. of lime, in a digester. We obtained by this experiment only neutral lime-soap, glycerine, and neutral or undecomposed oil, and no trace of free fat acid whatever.

Q. 54. Explain wherein defendants' processes, as described in their original and supplementary answers filed in this suit, resemble or differ from the process described in Radley & Meyer's patent.

A. Defendants convert one portion of fat into lime-soap, the remainder into free fat acid by water at high temperature and pressure. Radley & Meyer turn all the fat into lime-soap, or soda-soap, or part into soap, and leave the balance as neutral fat, and do not in either case turn any of the fat into free fat acids by the action of water at high temperature and pressure.

Q. 55. Examine Defendants' Exhibit 11, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant.

A. It contains no such evidence. Valerine, butyrine, and acetine, are not the oils and fats of commerce, nor are the acids it refers to, valerianic, butyric, and acetic or vinegar, the fat acids used in candle and soap manufacture.

Q. 56. Examine Defendants' Exhibit 12, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant?

A. It does not. It refers to Scharling's production of fat acids, in a state of vapor, by distillation, by means of superheated steam passed through fats at high temperatures. The process is the same as Dubrunfaut's, referred to in Exhibit 8, and differs in all respects from Tilghman's.

In Scharling's, free fat acid, as vapor, is distilled over and con-
501 densed. In Tilghman's, free fat acid is produced as liquid, and remains so. In Scharling's, open vessels are used. In Tilghman's, close vessels are used. In Scharling's, no pressure is enjoined. In Tilghman's, high pressure is necessary. In Scharling's, no liquid water is or can be mixed. In Tilghman's, liquid water is mixed, and is the chemical agent of change. In Scharling's, no mention is made of the production of glycerine. In Tilghman's, glycerine is produced and found in solution.

Q. 57. Examine Defendants' Exhibit 13, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant.

A. Exhibit 13 contains no such evidence. It describes a process for melting raw tallow or suet with water, and then squeezing the product to separate the oily portion from the solid. It does not state that high temperatures or pressures are used. It does not mention or refer to the production of any fat acid or glycerine, but expressly states that the

process does not tend to alter the fatty bodies; the French word "alterer" being used in the original.

Q. 58. Examine Defendants' Exhibit 14, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant.

A. Exhibit 14 does not contain any such evidence. It describes Appert's process for melting or rendering raw fat or suet, in close vessels, at a temperature of 239° to 268° Fa'r., equal to a pressure of from twelve to twenty-four pounds to the square inch. It does not say that any fat acid or glycerine is formed, but, on the contrary, speaks of the product as being still "tallow." This process is essentially the same as that well known as the Wilson tank-process for rendering lard.

Q. 59. Examine defendants' Exhibit 15, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant.

A. Exhibit 15 does not contain any such evidence. I have examined the patent granted to N. H. Manicler, No. 5345. It is substantially the same process as that in Exhibit 14. Fat, with one-sixth water, is heated in a digester to about fifteen pounds pressure; is then cooled and pressed between cloths to separate the oil. It does not state that any fat acid or glycerine is produced, but, on the contrary, the product is called tallow. The fluid part is stated to be fit for burning in lamps or for oiling machinery, which proves conclusively that it was not fat acid,
since fat acids, as is well known, are not adapted to either of
502 these uses. Mixing with "oil of turpentine" is stated to produce the same effect on the fat as the treatment in the digester, and this is another and conclusive proof that the fat was not decomposed.

Q. 60. Examine Defendants' Exhibit 16, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant.

A. It does not contain any such evidence. I have examined the patent of Collier & Manicler referred to. It is for applying to palm-oil the same kind of treatment as Exhibit 15 applied to other fats, and the produce is described to be the same. No mention is made of any fat acid or glycerine being produced, and the liquid oil is stated to be suitable for burning in lamps, which proves conclusively that the product was neutral fat, and not fat acid.

Q. 61. Examine Defendants' Exhibit, No. 17, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant.

A. Exhibit 17 does not contain any such evidence. I have examined the patent of Walther, No. 8752. It describes a process for distilling off the volatile, bad-smelling portion of the oils and fats, by passing currents of high-pressure steam through them while contained in a digester under pressure. The steam escaping by the safety-valve carries with it the volatile oils, which are condensed separately, and the oil is made more pure and more suitable for burning in lamps. It is not stated that any fat acid or glycerine is produced, and the fact that the oil after being thus treated was "more suitable for burning in lamps" than before, proves conclusively that it was not converted into fat acid.

Q. 62. Examine Defendants' Exhibit No. 20, (Hirschfeld's patent,) and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant. Explain the processes described in said Exhibit, and state wherein they resemble or differ from complainant's process.

A. Exhibit 20 does not contain any evidence of a prior knowledge or use of complainant's process. It describes a Papin's digester with another vessel inside of it, the space between being filled with water. In this apparatus two processes are described as being performed; first, the inner vessel is nearly filled with raw fat, the same being cut up, and either pure water or very dilute sulphuric acid poured on it; the digester is then closed and put on the fire for two hours;
503 the tallow is then filtered and pressed. The process is described as a mode of rendering tallow. Its advantages are said to be the production of purified tallow without loss in the crackling or by volatilization, and with more certainty than by the ordinary means. If the tallow is to be decomposed at the same time the second process is to be used. In this, to one hundred weight of raw material two pounds of sulphuric acid and thirty-two pounds of water are added, and the further treatment is the same as before. In this case the product is called the "rendered decomposed mass," and is to be allowed to stand for two or three days and then to be pressed. The only difference between the second process and the first is the use of two per cent. of sulphuric acid, and consequently the difference of the products or the decomposition spoken of in the second process must be due to the use of this sulphuric acid. The first process differs from complainant's in producing "tallow" and not fat acids. The second process differs from complainant's in using sulphuric acid to decompose fat instead of water at high temperature and pressure. It is not stated distinctly that a high temperature or pressure is used in either case.

Q. 63. Examine Defendants' Exhibit No. 21, (Wilson's tank process,) and the context on pages 341, 342, and 343 of Morfitt's Chemistry, and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant. Explain said process and state wherein it resembles or differs from complainant's process.

A. Exhibit 21 does not contain any such evidence. Wilson's process is for rendering tallow or lard, by subjecting the raw fats in a close vessel to steam, of from fifty to one hundred pounds pressure, for ten to fifteen hours; it is then left to settle, when the water and impurities subside and the fat is drawn off. The product is stated to be lard or tallow, and to be particularly "pure" and of good quality. It is also called refined tallow. It is nowhere stated that any fat acids or glycerine are produced. This process resembles Tilghman's only in the fact that fats are exposed to the action of steam, and incidentally to the condensed water in a close vessel at a high temperature and pressure. It differs from Tilghman's in the fact that the action of the steam and water in Wilson's process is merely to melt the fat and dissolve the gelatinous membranes which envelop it, while in Tilghman's process the action of the highly-heated water decomposes the fat and converts it into fat acids and glycerine. Wilson's process produces what is known and used in the arts as commercial lard or tallow, that is,
504 fats which are practically used as neutral fats. Tilghman's process produces what is known and used in the arts as fat acids. The fat of animals is composed of a great number of cells or sacs of thin membrane, which envelop and contain the true fatty substance. When steam is admitted it would heat the surfaces of the lumps of raw fat, the fatty matter inside of the small cells would melt and expand by the heat, the cells would burst open and the melted fat would run down with the condensed water. As the heat increased, the membranes would gradually dissolve in the condensed water, forming a solution of glue or gelatine; at the bottom would be a layer of water holding in solu-

tion gelatine, blood, and other fluids extracted from the flesh adhering to the rough fats. Floating in this soup-like solution and on its surface would be a mass of pieces of half-melted fat and undissolved membranes, and on the top would be a stratum of liquid melted fat; any bones would of course settle to the bottom grating or diaphragm.

Q. 64. Would the condition you have mentioned of a quantity of gelatine or glue dissolved in the water, and a separating stratum of solid matter between the water and the fluid fat be favorable or unfavorable for the decomposition of the fat by water into fat acids and glycerine?

A. Since a mixture of water with the fat is essential under the circumstances of temperature and pressure to the production of free fat acids, and since there must be, according to the description of Wilson's process, a considerable quantity of the animal matter interposed between the bottom stratum of soup-like liquid and the top stratum of melted fat, I conceived it to be a most unfavorable condition for the production of any decomposing action by the water upon the fat, admitting even that the water so surcharged with animal matter dissolved should have the ability to decompose the fat into free fat acids should they be brought in contact.

Q. 65. Do any of the defendants' exhibits, Nos. 1 to 21, contain a description of a process substantially resembling the process patented to complainant in principle and operation, or an announcement of the fundamental chemical fact upon which complainant's process is based, to wit, the decomposition of fat into fat acids and glycerine by the action of water at a high temperature and pressure?

A. I have studied very carefully and critically, with reference to the meaning of the language employed, the documents and treatises
505 containing the matter brought forward in said exhibits, and I have been unable to recognize in any one of the descriptions a process substantially resembling the process patented to complainant; nor can I see in them any announcement of the fundamental chemical fact upon which the complainant's process is based—the decomposition of fats into fat acids and glycerine by the action of water at a high temperature and pressure.

Q. 66. Examine the condensed statement of the points of difference between complainant's process and the several processes described in defendants' exhibits, made by Professor B ooth in his testimony in this suit in answer to question 136, in-chief, and now shown you. State whether in your opinion the points of difference are fairly and correctly stated by Professor Booth, and whether you confirm and adopt said statement.

A. I have examined the statement referred to in the question, and am of the opinion that the points of difference are fairly and correctly stated, and I do fully confirm and adopt said statement.

Cross-examined by C. B. Collier, esq.:

X Q. 67. You have, in the course of this examination, had before you and read from manuscript, have you not?

A. I have.

X Q. 68. Will you please state the character of such manuscript, and when and by whom it was prepared?

A. The manuscript consists in a number of questions given to me by Mr. B. C. Tilghman, complainants counsel, within a month after previous interviews at complainant's laboratory, at Professor Booth's laboratory, and at my own office, running over a space of one year. To these

questions I have in part written out the answers, and in part delivered the answers as the form of language was suggested as it came up in the course of this examination.

X Q. 69. Have you any objections to attaching said manuscript to this deposition as an exhibit?

A. I have not the slightest objection, provided it be understood that it be taken as my full notes and memoranda, and not as my full testimony as it has been recorded.

(The manuscript called for by defendants' counsel is here put in evidence, and marked by the examiner Defendants' Exhibit, Rogers No. 1.

(Counsel for respondents does now enter his objection and protest to the introduction of the foregoing deposition for the reason that the same appears to have been prepared and given in a
506 manner contrary to the established rules regulating the taking of testimony, and, thus objecting and protesting, counsel proceeds to cross-examine the witness.)

X Q. 70. Is it your opinion that fats can be decomposed by the vapor of water as such?

A. Fats can be decomposed by the vapor of water at a high temperature as shown in Dubrunfaut's process, wherein fats are spoken of as resolved into fat acids and acroleine, and as shown in Scharling's process, wherein neutral fats treated with superheated steam furnished fat acids with neither acroleine nor sebacic acid. He does not mention glycerine, but since his temperature was below the heat destructive of glycerine it may be inferred that it was there also. Wilson and Payne distilled neutral fats with superheated steam at 570°, and they obtained both fat acids and glycerine. It is to be observed in this connection that the processes were all processes of distillation.

X Q. 71. Then I understand that it is your opinion that fats can be decomposed by the action of steam with free fat-acids and glycerine as the resulting products; am I correct?

A. Yes, sir, fats can; as I have stated, citing the above authorities, that when fats are distilled, that is to say, vaporized through the agency of high steam which, exercising its peculiar displacing poper, sweeps them along to be condensed into liquid or solid form when cooled in other vessels.

X Q. 72. In such decomposition, do the elements of water combine with the elements of fat acid existing in the fats to form free fat acids?

A. It is the adopted view of chemists that hydrogen and oxygen, which are the elements of water, do associate themselves with the elements of fat acids in the fats and form free fat acids.

X Q. 73. And again, do the elements of water in such decomposition combine with the elements of glycerine existing in the fats to form solution of glycerine?

A. Oxygen and hydrogen, which are the elements of water, do, under the circumstances stated in the answer to X Q. 70, combine with the elements of glycerine in fats to form glycerine.

X Q. 74. Is it not your opinion that in Scharling's process, Exhibit No. 12, glycerine, as well as free fat-acids, was produced?

A. From the fact that it is positively stated that fat acids were produced, and that no acroleine nor sebacic acid was formed, and not knowing any other product that would likely ensue, I would
507 infer, (though Scharling fails to mention, if indeed he knew it,) that glycerine was a product.

X Q. 75. Then in Scharling's process, the resulting products of the decomposition of fats were the same as in complainant's process, were they not?

A. Scharling's own statements give me the only information which I have upon his particular process and products; and therefore I can only repeat, in the absence of any statement from him, that glycerine was produced: that it is my inference; and assuming the veracity of his account, I have no doubt that fat acids were produced.

X Q. 76. And in such production of fat acids and glycerine, did not the chemical combination of the elements of water therewith take place at a high temperature?

A. The union of the elements of water, so far as it took place in the case of the fat acids, and may be inferred as taking place in the production of glycerine, must necessarily have occurred at the temperature of 320°, which is that which he describes as having used.

X Q. 77. You do not mean to be understood, do you, as conveying the impression that a decomposition of the water or vapor of water takes place in such decomposition of fats?

A. I desire to be understood as meaning that in the decomposition of fats through the agency of superheated steam, as in the process of Scharling, it is the hydrogen and oxygen in that particular physical condition of water known as vapor, which go to the formation of the fat acid, and to the production of the inferred glycerine. And that it is the hydrogen and oxygen of water in that other particular physical condition known as a liquid, which go the formation of the fat acids and glycerine in those processes, whereby saponification is accomplished, and in that distinctive process of Tilghman, wherein water alone is the agent of the decomposition of fats under high temperature and pressure.

Examination adjourned to to-morrow (Friday) morning, at 10 o'clock.

FRIDAY, *March 19th*, 10 *a. m.*

Present, B. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

Cross-examination of Robert E. Rogers resumed:

X Q. 78. In the examination of Professor Booth in this cause,
508 he was asked, X Q. 295, "Will you now state the precise difference, if any, in the chemical principles and affinities involved in such decomposition of fats into free fat acids and solution of glycerine by the action of highly-heated steam, on the one hand, and highly-heated water on the other?" To which he answered: "If free fat acids and solution of glycerine be formed in either case, the chemicals principles and affinities involved, namely, the assumption of the element of water, in order to form free fat acids and solution of glycerine, are the same in both." Do you concur with Professor Booth in such opinion?

A. I can only answer this question by going into some detail of explanation. Both the question and the answer, as read to me, require a very careful examination into the meaning of words used. When it is stated that the chemical principles and affinities are the same between that process whereby fats are resolved into free fat acids and glycerine by highly heated vapor of water, on the one hand, and are resolved into free fat acids and glycerine by liquid water under high temperature and pressure on the other hand, we can only affirm that the elements of water, as hydrogen and oxygen, are assumed in the production of the two products named in both of the processes; and, secondly, that the ends attained, whatever may be the intermediate stages, are likewise in the two the same. But to say that the affinities which are brought into play in each case are the same, is not to say that those affinities constitute the process by which they are awakened. If we mean by "chemical principles," simply the fact that the oxygen and hydrogen of water

are made to play a part in the production of the fat acids and glycerine in the two processes, then I agree with Professor Booth in the use of the word "principle;" but, if by this term chemical principle, it is meant that the processes by which those chemical affinities of hydrogen and oxygen are awakened, are the same in the two operations referred to in the question, then I do not concur with Professor Booth in the use of that expression. But I would state, however, that I think Professor Booth and I do in fact fully agree in reference to the points included in this question, and that his answer was intended, when he speaks of identical chemical affinity and chemical principle, to simply assert that the same substances, namely, oxygen and hydrogen, were through chemical affinity assumed by the fat in the production of fat acids and glycerine, and that he did not mean that the processes, in the proper meaning of that term, involving totally different conditions, are identical with each other. We might as well maintain that the process by which starch is converted into grape sugar, or glucose, (having assumed or appropriated for that conversion the elements, hydrogen and oxygen of water,) when it is accomplished by the treatment of that starch with caustic potassa, at a moderate temperature, is the same process by which that starch could be converted into glucose by sulphuric acid, and is the same process again by which that starch is converted into glucose by diastase or yeast, as to say that the two processes, each of which invokes or awakens the chemical affinities of hydrogen and oxygen in the formation of fat acids and glycerine are identical. We are only able to recognize results in either of the processes before named. We only know in the instance of the glycerine and fat acids, and in the case of starch and glucose, that hydrogen and oxygen play a part; that their affinities are awakened; but we see from the physical and chemical nature of the substances employed that the processes which bring about the changes are altogether different. While we speak of the chemical affinity of elements, we must not ignore the fact, that in a great many actions of chemistry and processes in the arts, the physical condition of the substances engaged often in a large degree modifies, if not altogether controls, the results. In the process by highly-heated vapor, the elements oxygen and hydrogen of water are in one physical condition, and in the process of Tilghman, the elements of water are in a totally different physical condition.

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X Q. 79. From a chemical standpoint, is the decomposition of fats into free fat acids and solution of glycerine by steam, on the one hand, and the decomposition of fats into free fat acids and solution of glycerine by water, on the other hand, the same chemical fact or discovery?

A. From a chemical standpoint, it can be properly affirmed that the two results are the same chemical fact only so far as that the substances, namely, the oxygen and hydrogen of water, which bear a part, are the same in the two; and so far as that the products, namely, fat acids and glycerine, which are formed, are also the same in the two; but from our chemical view we have no right to assert that the interior affinities and forces, which operate in that case wherein water is as vapor, are the same with those chemical affinities and forces which operate wherein water is a liquid. Indeed, from the very circumstance of the two substances, the vapor and the liquid, being so unlike each other in their physical conditions, it might, if we were inclined to speculate on the subject, be affirmed that those controlling forces, though they ended in the same result, were somewhat different.

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X Q. 80. In what sense do you use the word "forces?"

A. I use the term "forces" as referring to the powerful repulsive

tendency which is allowed to operate to separate the particles of water in a vaporous condition, in the case of the highly-heated steam process, wherein, by its escape, the vapor impetuously passing through the fat, exercises a displacing power over the constituents of the fat, bringing them into a condition to combine with the elements, hydrogen and oxygen, to form and sweep along the products, fat acids and glycerine; and to that other condition, in which (in Tilghman's process) the particles of water, so far from being allowed freely to separate from each other, are constrained by a high pressure to occupy a smaller space than naturally, and are thus, therefore, permitted to present themselves to the fat in greater number within a given space. It is well known that the same substance, under the two different conditions, the one of dilatation and the other of compression, often exercises unequal affinities, and sometimes even different ones in each. Thus: carbonic acid is capable of three separate states—the solid, the liquid, and the gaseous. The chemical activities of this substance in those states are very different for each.

X Q. 81. Then the highly-heated steam exercises a two-fold power, does it not—one a mechanical displacing force, and the other a chemical combining one?

A. In my own mind, I have no doubt that both of these forces operate; but I am of opinion that these are by no means all of the influences concerned in the operations. (We know that the force of cohesion is different in liquids from that in vapors. We know that electrical states prevail throughout, or can be developed in liquids and vapors very differently or unequally. We know that what are termed polarities, and also, according to modern chemical research, molecular arrangement, or the arrangement of particles is different in bodies of such opposite physical state, and, therefore, it would be little else than hypothesis to attempt to describe those internal atomic actions and conditions which take place in the two cases respectively. It appears to me, that seeing the means are so different in their details by which the products are obtained, though said products are identical, that we cannot but conclude that the complex internal reactions, producing the results, must be different in the two cases.)

511 (That portion of the foregoing answer in parenthesis objected to by counsel for defendants, as being irresponsive to the question, argumentative, and matter confessedly of hypothesis.)

X Q. 82. In the defendants' processes, as described in their original and supplemental answers, is not highly-heated steam continually present and operative as an active and energetic agent?

A. Highly-heated steam is present in defendants' processes; but I do not regard it, under the circumstances, a highly active and energetic agent. It is the water, under high temperature and pressure, which is present, that is the active and energetic agent, apart from the lime, which is described as being present in limited quantity, sufficient for only a partial saponification of the fat.

X Q. 83. Does not the steam upon its introduction into defendants' digesters, and while present there, come continually in contact with the fat there present?

A. Assuming that the contents consisting of fat, water, and lime are at the commencement of the operation cold, upon the first admission of the highly-heated steam it will rush rapidly in and diffuse itself throughout the mixture, and be immediately condensed into water by the substances with which it comes in contact. This will continue to be the case until said contents and the water so derived from condensation

shall have all attained a temperature due to the temperature and pressure of said steam. When this point has been reached the further entrance of the steam will be arrested, excepting so far as the vessel with its contents may lose heat by radiation or conduction, and thus promote a slow condensation. There being, however, a safety-valve provided on the digester loaded to a pressure less than that of the boiler steam, a vent for the steam is permitted which is described as to be continued for a period of from eight to ten hours. So far, therefore, as this steam is permitted to escape so far will it enter the digester and mingle with its contents, and transport in its circulation each material in turn in contact with each other, thus, I conceive, bringing the lime into play upon so much of the fat as it can decompose, and the liquid water into play upon so much of the fat as it can decompose.

X Q. 84. How long, in your opinion, after the first introduction of the superheated steam will the water be brought to the temperature of vaporization in defendants' digesters?

A. Not having seen such a digester as alluded to, with its prescribed contents operated, I am unable to say what time would be required for such a result. To answer the question at all correctly
512 without such opportunity or experiment could only be done by obtaining further data than given in the question, namely, the rapidity with which the steam should be let in, the season of the year when the operation would be performed, the temperature of the materials within the digester when the process is started, and then by a calculation taking into accounnt the quantity of materials employed and their respective specific and latent heats.

X Q. 85. Steam being continually present and constantly introduced in defendants' processes, and steam being confessedly a decomposing agent, how are you able to say that it is not the steam and is the water which decomposes the fats in defendants' processes?

(Complainant's counsel objects, that the question assumes that steam is confessedly a decomposing agent, whereas there is no proof that, under the conditions existing in defendants' digester, (namely, the presence of a large quantity of liquid water mixed with the fat,) steam exercises any decomposing agency.)

A. We know that water under high temperature and pressure will decompose fats into fat acids and glycerine, and we know that in defendants' digester there is a large quantity of water under such temperature and pressure, and we know further that that water is kept constantly circulating and in contact with the fat, the very conditions of Tilghman's process, and therefore we feel assured that water does accomplish the decomposition of the fats. The only processes by which neutral fats furnish fat acids by steam are processes specifically described as those of distillation, and by distillation is meant the carrying over of the fat acids along with the vapor of water or of glycerine by the same (or of the decomposed products of glycerine such as acroleine) and their subsequent condensation. I have yet to see in the publications of defendants any statement to the effect that there pass by the outlet of the safety-valve such products of distillation. Since, therefore, the process is not one of distillation, but one in which the fat acids and glycerine and lime-soap are all found in solution or mixture in the water in the digester, my only conclusion is that it is not the steam but the water and the lime, which have accomplished the decomposition.

X Q. 86. In defendants' supplemental answer describing the process now employed by them is the following language: "This escaping steam is condensed, and the glycerine-water arising from such condensa-

513 tion is then drawn off for condensation, (concentration.") In view of this have you any modification to make of your last answer?

A. The modification which I would desire in my answer is the substitution of the word "and" for the word "or," between the word "water" and the word "of," so that the sentence will read "the only processes by which neutral fats furnish fat acids by steam are processes specifically described as those of distillation, and by distillation is meant the carrying over of the fat acids along with the vapor of water and of glycerine by the same," &c.

X Q. 87. Do you not believe that superheated steam will decompose fats producing free fat acids and solution of glycerine?

A. I do, when the same is accomplished by the arrangements for and in the process of distillation of the same, and my source of information is in the descriptions given for the processes of Dubrunfaut, Scharling, and Wilson & Payne.

X Q. 88. Do you know that the presence of liquid water with the fats will prevent the decomposing action of highly-heated steam, which is forced into a mixture of fat and water, and which is continually present during the process of decomposition as in defendants' processes?

A. I do not know that such is the fact, and until I shall be furnished with a clear proof of it I should doubt whether such is the case.

X Q. 89. And if the decomposition of the fats is effected by the steam and not by the water, would not the resulting products be found at the conclusion of the operation in the same state of admixture in which they are found to exist in defendants' processes?

A. For fear that from misapprehension of the particular point of the question I may not correctly meet it, I would ask whether the inquiry is made with reference to the specific processes of defendants, or to those processes of distillation to which I have referred.

(Counsel for defendants informs the witness that the question relates to defendants' processes, and furthermore that by the words "conclusion of the operation" is meant after condensation of the steam has occurred, and the products are allowed to stand in the digester for the time stated in defendants' answers.)

If the fats are decomposed by steam, a supposition not mine, but yours, and if that decomposition results in the production of fat acids and glycerine, then there can be no doubt that the fat acids and
514 glycerine which are supposed to be so liberated, would, upon the cooling down of the materials of the digester, be found as fat acids and glycerine, and fat acids and glycerine are always fat acids and glycerine whether they are produced by one series of reactions or another.

The glycerine in a condition dissolved in water and the fat acids in a liquid or semi-liquid or solid state according to the temperature, and the lime-soap would be found all mingled together or in separate strata according to the amount of settling. But I desire to be understood as giving this explanation having reference simply to the hypothesis of the steam producing these products, as in the hypothesis or supposition of the question.

X Q. 90. Then, from the condition in which the products, at the conclusion of defendants' process, are found, it is as reasonable to *to* infer, is it not, that the steam, and not the water, effected the decomposition?

A. A rational mind, when it reflects upon phenomena, and arrives at a conclusion, never does so in justice to truth by taking isolated conditions, but is bound to embrace, as the basis of its conclusions, all of the conditions of the question. If it had been proved that steam per se has

the power of decomposing fats into fat acids and glycerine, as it has been demonstrated that water at high temperature and pressure will do, then it might be a question whether a part of the decomposition of the fats was not the result of the steam as well as that of the water. But to assert that it is as reasonable to attribute the decomposition of the fats as well to the steam as to the water is, in my opinion, begging the question, to assume, in other words, the ability of steam per se to decompose fats, a fact which I do not think has been made out.

X Q. 91. X Q. 90 repeated.

A. Were I utterly ignorant of the powers or properties of chemical substances to decompose fatty matters, and were I told that in this digester of defendants there had been placed fatty matter, and further that that fatty matter had been decomposed into fat acids and glycerine, and had been told that such decomposition could be effected by steam as well as by water, and further that steam and water had both been used, then I would say that it was reasonable to suppose that steam as well as water had accomplished the decomposition. This would be a conclusion based upon statements made to me. But the mere finding of fat acids and glycerine which have resulted from the decomposition of fats in defendants' digester would not, with my
515 knowledge of chemistry, lead me to attribute the production of the fat acids and glycerine as reasonably to the action of steam as to that of water.

X Q. 92. In the defendants' process, lime in the form of milk of lime is present as an active agent, is it not?

A. It is to the extent of its neutralizing power over fat acids.

X Q. 93. During the continuance of the operation in defendants' process, does this lime come in contact with only that portion of the fat from which it extracts the fat acids?

A. Viewing it from a chemical point of view, I would say that the lime comes within the contact of affinity only, with just that amount of the fat acids with which it is found combined at the end of the operation. But since the process of saponification is one of time, there cannot be a doubt that the small portions of the disseminated lime rub against, and, in that sense, come in contact with a great deal of the fat with the acid of which it does not combine.

X Q. 94. And would not the particles of lime, coming in contact with or rubbing against a large portion of the fat, have a tendency to decompose such fat?

A. They not only have the tendency, but when sufficiently subdivided and brought within the sphere of mutual affinity do actually combine with the fat acids; but it must be distinctly understood that only so much of the fat acids will be taken up by the lime as corresponds, in chemical language, with the proper chemical equivalent.

X Q. 95. I understand you to say that the finely-divided particles of lime, during the operation, would come in contact with a large part of the fat present; and that, so coming in contact, the lime would tend to decompose all of the fat with which it did come in contact. Am I correct?

A. You are not correct in so understanding me, and, if you refer to my answer just given you will see that I have spoken of the particles of lime as coming in chemical contact, or within the range of chemical affinity with just so much fat acids as it combines with; and that I have spoken of the finely-divided portions, not particles of the lime which rub, as it were, against the fatty material in the process of circulating. To be, perhaps, still more clear—a part of the lime is dis-

solved in water—a part of it is in suspension ; the lime dissolved in the water, as it meets with the particles of the fat, is in a state ready for chemical affinity ; but the portions of lime suspended in the water
516 are capable of only what is called physical contact. As the lime is successively appropriated by the fat acids out of the water, new lime, in turn from that mechanically suspended, is dissolved. And thus I conceive the whole process to go on until all of the soluble lime has been neutralized by its equivalent of fat acids.

X Q. 96. Is not the first contact of the lime, whether in solution or in suspended particles with the fat, a physical one ?

A. So far as the fact of there being what we conceive to be particles of matter, and since these particles of matter are conceived through their condition of solution to be exceedingly closely approximated, I would say, that stopping just here, we are contemplating physical conditions. But the particles themselves do not stop here; since obeying an affinity, they lose their individuality, and assume the condition of a new or compound body. Sulphuric acid mentally may be said to touch potassa, but sulphuric acid cannot touch potassa actually under the influence of chemical affinity without each losing its individuality for the time, and merging in a third body—sulphate of potassa.

X Q. 97. Is it not through the contact, first physical or mechanical, of the lime with the fat that the decomposition and consequent chemical combination of fat acids and lime is effected ?

A. The words of scientific language have been adopted and used to convey definite meanings. Thus when physical contact is spoken of it is all the world over understood to mean very differently from chemical affinity. Physical contact is what we call touching. The particles of matter ordinarily spoken of as in contact are well known to be at variable distances from each other, according to the substance, pressure, or heat applied, and these distances are measurable in many instances; whereas, in bodies which are united by chemical affinity, the association of the particles is so intimate that their distance is inappreciable, and that we no longer speak of them as separate from each other.

X Q. 98. Then there is no mechanical or physical contact between the lime and fat preceding the chemical combination of lime and fat acids; is that so ?

A. Since all chemical actions are produced by bringing bodies near enough to each other to be within the range of each other, to be within the range of chemical union, we necessarily begin by having the substances widely separate from each other. They may then be approached, then still further approximated, and then brought
517 nearer still; until, if the eye of man or his optical instrument could still further follow and detect the progress of approach, he would doubtless see, for an instant of time, the moment when, from the condition of separate particles, they had suddenly lost their individuality and transformed themselves into a third body. If such could be done, the observer would say that he saw the particles in what he would call contact; and the instant afterwards they were a new body under the force of chemical affinity, and, in this sense, the word physical contact and chemical affinity are contradistinguished from each other.

X Q. 99. Will not the lime present in defendants' process exert an influence upon that portion of the fat from which it does not extract the fat acid ?

A. Answering from what I have learned with reference to the process of a party or parties now operating in the West under Mr. Tilghman's process, wherein they depend upon water as the agent of decomposition,

and add to the fat and water a minute quantity of lime, I should say that I understand they are of the opinion that this small quantity of lime, in some unexplained manner to them, promotes a more rapid action of the water upon the fats.

X Q. 100. In the deposition of N. Ropes, taken on behalf of the defendants in the original suit against M. Werk, in answer to Q. 4, he says in part as follows: "The time for cooking depends measurably upon the quantity of lime used in connection with the water; with no lime a good stock, well crystallized, has been produced in twenty hours. With one-half per cent. of lime it usually takes about six hours, and probably it could be done in a shorter time with from one to two per cent. of lime. But under all circumstances the same pressure must be applied." Upon the hypothesis that the statement of Mr. Ropes, as above quoted, is true, do you not infer that the lime exerts an influence upon the entire mass of fat, and aids in the decomposition of the entire mass?

A. I infer, assuming the correctness of Ropes' statements, that the small quantity of lime exerts an influence which ends in the conversion of the entire mass of fat, and aids the result which is obtained upon the whole mass; but I by no means infer that the minute quantity of lime employed combines with the entire mass of fat, or that if it combine at all it does so in more than its equivalent quantity. In what peculiar manner so small an amount of lime acts I could not undertake to say until careful observations and experiments were made. To assume that this minute quantity of lime could chemically combine with all the fat
518 acids present would be preposterous and contradict the established laws of chemistry. We do know, however, that small quantities of substances frequently, through indirect action, are capable of inducing chemical actions between large bodies of other matter, as in the case of the making of vinegar from diluted whisky poured over shavings which are charged with a minute quantity of yeast, not to name others.

X Q. 101. If the fact as testified to by Mr. Ropes be true, then, also, in defendants' process the lime present aids in the decomposition of the entire mass of fat, does it not?

A. I have no doubt it does. I have no doubt that the lime exercises its decomposing power upon so much of the fat which it in equivalent quantity is capable of combining with; and if Mr. Ropes' statements are correct it tends to the final result; but by this I do not mean to say that the lime used by defendants by any means combines with all of the fat acids, or that it is in itself which separates the fat acids from the glycerine. Whatever may have been the instrumentality of the lime, it is, in my opinion, the water which decomposes all of that quantity of the fat which has not been taken up by the equivalent quantity of lime. Whatever the lime may be instrumental in promoting, it certainly, without the water, would not decompose more of the fat than due to its own specific chemical equivalent.

X Q. 102. And if the fact be true as testified by Ropes, then that portion of the fat in defendants' process with which the lime does not chemically combine is decomposed by the united or combined influence of the water or the steam, or both, and the lime, is it not?

A. Knowing nothing as to the ability of the steam in defendants' process to decompose fats into fat acids and glycerine, I am unable to include it in my answer. Assuming the correctness of Ropes' statement, I would say that the combined presence of the lime and water is instrumental in the decomposition of that portion of the fats referred to in the

question, but would again state that I still regard the water as the real agent of that entire decomposition. The lime might destroy some little unrecognized foreign matter in the tallow, and leave more freely to act the water upon the fat. Thus in the vinegar operation to which I have referred, showing how small an amount of substance may operate, if the minutest quantity of oil of turpentine be present in the shavings the whole process of acetification is arrested.

519 Examination adjourned to to-morrow (Saturday) morning, at 10 o'clock.

SATURDAY, *March 20th*, 10 *a. m.*

Present, B. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

Cross-examination of Robert E. Rogers resumed:

X Q. 103. In the complainant's patent is the following language: 'The hot mixture of fat acids and solution of glycerine which escapes from the exit-valve of the apparatus separates by subsidence." Will you please state the nature or character of the admixture thus escaping in complainant's process? In other words, will you state where in such admixtures the fat acids will be found, and where the glycerine, after separation?

A. The mixture, as I understand it to be, is one of water, holding in solution glycerine and the fat acids, and when subsidence and cooling have taken place the watery solution of glycerine would be found as the lower stratum and the fat acids as the upper one, as a consequence of their relative specific gravities, though I would add that I have no doubt there would be held or retained, entangled by the fat, more or less of the watery solution of the glycerine. Indeed, not having seen the operation upon the manufacturing scale, I do not know but the materials will be found intimately mingled with each other without any separation into strata, a condition of things which I have witnessed in practical operation of a small coil by Mr. Tilghman.

X Q. 104. Is the specific gravity of free fat acids greater or less than that of water containing glycerine in solution?

A. The free fat acids, under the circumstances of heat of Mr. Tilghman's process, would, in my opinion, float upon the surface of the solution of glycerine, provided a separation of the two substances took place.

X Q. 105. You have stated in your examination-in-chief, if I correctly understand you, that defendants' product consists in part of lime-soap, in part of free fat acids, and in part of glycerine held in solution by the water. Can you state why the "free fat acid" part of the product is not found upon the surface of the water, separate from the lime-soap, at the conclusion of defendants' operation?

A. They do not separate from each other because the free fat
520 acid and the lime-soap are mutually, so to speak, soluble in each other, and in that condition of intimate association they would naturally rise or fall together, if left in a condition perfectly free to do so, according to the relative proportion of the two materials, and in a degree dependent upon the temperature.

X Q. 106. Do you find a minimum degree of heat and pressure stated in complainant's patent for the practice of his process? If so, please state what such minimum degree of heat and pressure is.

A. I do not find in complainant's patent any statement of a minimum

degree of heat and pressure to which he restricts himself in his process. I find in complainant's patent the following statement: "But the change of fatty matters into fat acid and glycerine takes place in some materials (such as palm-oil) at or below the melting-point of bismuth, yet the heat has been carried considerably above the melting-point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat, and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty bodies employed can easily be determined."

X Q. 107. Is not tin, melting at about 440° F., the lowest of the series employed by complainant for measuring the heat contemplated in his patent?

A. Desiring to make my answers so that they shall be consistent with each other by being clearly understood, I would first state that I read in complainant's patent the following sentence: "The series I have used consists of tin melting at about 440° F.; bismuth at about 510° F.; lead at about 612° F., and nitrate of potash at about 660° F." Now as I understand the description to be one referring to a practical operation, he has found the temperatures here designated to give a range in which the results are attainable most promptly, economically, and satisfactorily. But I do not understand that by selecting these, or any one of these degrees of temperature as his choice, he by any means intends to convey the idea that a chemical reaction of water upon fats does not take place at either lower or higher temperatures, nor that if he chose to bestow more time upon the process he could not perform it at lower heat and pressure, or chose to construct vessels of greater strength he could not perform it at higher temperatures and pressures.

521 X Q. 108. In the English letters-patent of the complainant is the following language: "The second part of my said invention consists of a mode of treating fatty matters, whether acid or neutral, and a carbonated alkali, for the purpose of manufacturing soap. * * * The degree of heat required is less than that which is necessary to produce free fat acids and should generally be kept between the melting-points of tin and bismuth." What inference do you draw from this statement as to the degree of heat contemplated by the complainant for the production of free fat acids by the action of water?

(Complainant's counsel objects that the English patent of R. A. Tilghman is not in issue in this suit.)

A. The inference which I draw is, that (as a manufacturing process, to be prompt, economical, and more satisfactory,) he has found that this species of saponification will, as a general thing, take place at a lower temperature and pressure than the decomposition of fats by water, when the same is to be conducted commercially in an economical manner; and I have no doubt that his view was, that as the temperature of the materials in each process raised, the saponification would take place at a relatively lower temperature than the water decomposition; and that if the temperatures in both processes were lower, the saponification would take place at a lower relative temperature than the water decomposition; and that the specific temperature which he names for the saponification by alkaline carbonates was so mentioned as having reference to advantageous manufacture of the product.

X Q. 109. As a "manufacturing process," do you think the complainant's patent contemplates a lower degree of heat than between the melting-points of tin and bismuth, 440° F. to 510° F., for the decomposition of fats by the action of water alone?

A. I cannot undertake to say what was in the mind of Mr. Tilghman at the time of taking his patent, but I cannot but believe, being so good a chemist, that he did not either know or feel assured that lower temperatures than those named by him would produce the free fat acids; and I believe further that, not caring to prescribe temperatures that were not likely to be chosen, as involving more time and cost than necessary, his eye was directed to render it economically productive.

(The preceding answer is objected to as not being responsive to the question, and as being argumentative, and the question is repeated
522 with the request that the witness will answer it, not in view of what he supposes to have been in the mind of the patentee, but from what is contained in the letters-patent sued on herein.)

X Q. 110. X Q. 109 repeated.

(Question objected to, as the letters-patent are to be construed by the court.)

A. I believe that the complainant in the first place announces a discovery—that water at high temperature and pressure will decompose fats into fat acids and glycerine; that he announces it as a discovery of a result, without restricting it to the action of the water at any particular temperature or pressure; and, secondly, that looking to the application of this discovery to the purposes of manufacture of fat acids and glycerine in a manner prompt and economical, and, therefore, the most practically valuable, he announces those temperatures in his series as the ones he would prefer to use, and therefore would recommend.

X Q. 111. Passing to the Defendants' Exhibit No. 1, title "Change of fat in Perkins' engine by water, heat, and pressure," I understand you to state in your examination-in-chief that the fat in said engine was changed, and that such change was its conversion into neutral lime-soap; am I correct?

A. That is what I intended to be understood to say, namely, said fat was, in my opinion, converted into lime-soap.

X Q. 112. Do you find in said exhibit any mention of the employment of lime?

A. I do not find in the exhibit any statement of the employment of lime, but I find a statement therein, attributed to Faraday, which is as clear a declaration that lime was present as if he had stated that lime had been purposely introduced into the apparatus, for we read in that exhibit that the substance in question, which had been separated by him into a solid body and a more fluid one, yielded carbonate of lime upon being burned. The carbonate of lime proves the presence of lime, and it having been derived from the fatty compound named, is a clear proof that this lime, before it entered into composition with the fat acids, must have been within the Perkins apparatus.

X Q. 113. Does the fact of the presence of carbonate of lime of itself satisfy you that the fat in which it was found was not a fat acid but was a lime-soap?

A. No; the mere fact of the presence of carbonate of lime would not so satisfy me, since we know that fat acids which have been pre-
523 pared from lime-soap usually, if not always, contain a small trace of lime; and, therefore, when such fat acids are burned, that minute trace will show itself, as a residue, as carbonate of lime. But I would remark that the distinction, both physical and chemical, is very marked and unmistakable, and the fact of the substance being lime-soap or fat acid can be determined without difficulty. In reference to the particular altered substance described by Faraday I would say that the fact of its leaving "an ash," when burned, consisting principally of car-

bonate of lime, would, by the quantity of lime implied, satisfy me of its being lime-soap.

X Q. 114. Would not the fat acid of commerce referred to by you leave an ash "consisting principally of carbonate of lime," when burned?

A. They would leave a trace of such ash, composed of carbonate of lime, which, compared to the amount of the mass burned, would be very minute.

X Q. 115. What else would they leave than carbonate of lime as an ash?

A. Looking to the fact that no lime likely to be used in the saponification of fats would be absolutely pure lime, but would in all probability contain a small quantity of silica, and probably a trace of the ashes of the fuel with which it had burned, I would suppose that this minute residue, upon the burning of the fat acids, would contain some silica and some of the other materials of the fuel's ash—quantities, however, exceedingly minute.

X Q. 116. Exhibit 1 says, "It is rather lighter than water." Is that the property or characteristic of a lime-soap?

A. Lime-soap is so near the specific gravity of water that when it is heated in water it is inclined to float.

X Q. 117. How as to the comparative specific gravities of lime-soap and water, the lime-soap not being heated in the water?

A. If I remember rightly, in the compact cold state it is inclined to sink, but should it be warmed in water, and bubbles of air become entangled, and it then cools down, it would doubtless float upon the surface of the water. This is in conformity with an experiment participated in by me at Professor Booth's laboratory.

X Q. 118. Exhibit 1 says, "It dissolves readily in alkalies." Is that the property of a lime-soap?

A. It is.

X Q. 119. To what extent is a lime-soap soluble in hot alcohol?

A. It dissolves quite freely in hot alcohol, which on cooling is separated in flocculi in abundance.

524 X Q. 120. What proportion or percentage of a given quantity of lime-soap will be dissolved by hot alcohol?

A. I do not remember to have seen it stated, though I presume it may be found in some of the authorities, nor did I make a quantitative determination to that effect, but I may state that it was clearly seen to be what we would call very considerably soluble, if not largely so, in hot alcohol. So far as the stearic and margaric portions of the soap are concerned, this statement is applied, while I would state that the oleate of lime was not only soluble in the hot alcohol but remained dissolved when the liquid had cooled, and after the larger portion of the other lime-soaps had fallen.

X Q. 121. Would hot alcohol having a large proportion of lime-soap dissolved in it present a clear solution?

A. It would present a clear solution until it began to cool down, when the lime-soap in its progress of descent would, for the time being and until it had all deposited, obscure the transparency of the liquid.

X Q. 122. In your experiment how was the lime-soap prepared, and in what quantity?

A. The lime-soap was prepared with a view to the process supposed to have taken place in the Perkins engine, and therefore equal parts of olive-oil and tallow, with thirteen per cent. of lime to the hundred of the fat mixture used, and water, were placed in a close vessel and subjected to a temperature between the melting-points of tin and bismuth. The

quantity was some few ounces, judging from the capacity of the apparatus used.

X Q. 123. Did you assist in its preparation?

A. I did not directly participate in the handling of the materials nor in the heating of the apparatus and its contents; considering myself as associated with Professor Booth in these investigations, I assumed the correctness of his direct statements to me, saw the arrangements which he stated that he had used, and the product as it had been drawn from the vessel, and then did personally participate in its examination and qualitative analysis.

X Q. 124. What chemical tests, if any, did you subject the product to in order to ascertain whether it was a neutral lime-soap?

A. The chemical test to which I subjected it to prove that it was neutral and not acid, was litmus paper dipped into its alcoholic solution; and the tests showing that it was a lime-soap were, that it did not dissolve in ether, that it did not melt in boiling water, (212° F.,) that it
525 melted at a higher temperature, that in melting it finally burned like fat, and left a residue of carbonate of lime; that in boiling-hot moderately strong solution of potash it dissolved, giving it a turbid solution, thus proving by these several evidences, first, that it was neutral, and secondly, that it was lime-soap. Had it been the unconverted fat its melting temperature would have been far lower, not more than 100° F.; it would have dissolved more slowly in the hot potassa solution, and would not have given any turbidness due to the separation of lime, nor would it have left on burning an ash consisting of the carbonate of lime.

Examination adjourned to Monday morning next, at 10 o'clock.

MONDAY, *March 22d*, 10 *a. m.*

Present, Benj. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

Cross-examination of Robert E. Rogers resumed:

X Q. 125. The tests referred to in your last answer were not made for the purpose of ascertaining whether the substance under treatment was a lime-soap, were they?

A. Yes; they were made with a view to determine that fact, and, further, to trace the resemblance of differences between such a lime-soap and the product of Perkins' engine as described and examined by Faraday, and the difference between these two and fat acids.

X Q. 126. Would a lime-soap, such as made in the ordinary lime-saponification process, a full equivalent of lime being used, possess the characteristics such as described in Exhibit No. 1, the fat used being tallow and olive-oil in equal parts?

A. It would possess such characteristics.

X Q. 127. All of them?

A. It is my opinion (so far as we are able to interpret the language of Faraday, who does not speak of the presence of any unchanged fat) that it possesses all of them, excepting in being "always black and dirty," and in containing a trace of copper, which would not necessarily be present.

X Q. 128. From what source do you think the lime of this "lime-soap" in Perkins' engine was derived?

A. That is a point which it would be impossible for me to say. I can only feel a positive assurance that it was there, from Faraday's own statement of his having found it in the product in question.

526 X Q. 129. How long have you known that a neutral lime-soap

could be dissolved in hot alcohol, leaving a clear solution, from which flocculi would separate in abundance on cooling?

A. I have known that a neutral lime-soap, made by a mixture of tallow and olive-oil, as described in a previous answer and in Exhibit 1, would dissolve in hot alcohol, leaving a clear solution, from which flocculi would separate in abundance on cooling, for a period of about two weeks, I think; while I have been familiar with the fact, as a part of my chemical knowledge, for a great many years, that an ordinary neutral lime-soap would dissolve in hot alcohol, and deposit itself again in great measure as a white precipitate on cooling of the liquid.

X Q. 130. Exhibit 1 says, "The cold alcoholic solution on evaporation left a substance similar in many respects, but much softer, even fluid; it burnt in the same manner, leaving a slight ash of carbonate of lime." Do you think this describes the properties of a neutral lime-soap?

A. I think it does describe the properties of a neutral lime-soap when that lime-soap is in great part, if not all, an oleate of lime.

X Q. 131. You think, then, that the "flocculi" in Exhibit 1 were the stearate of lime, do you?

A. I do; I have no reason to doubt that they were any other than that substance.

X Q. 132. Exhibit 1 says: "It undergoes no change in appearance when left for many weeks; but, when filtered through good filtering paper, the latter portions come through clear and transparent, the altered fat being separated. When evaporated, it leaves a substance having all the properties of the solid matter above described." Is this a characteristic of a neutral lime-soap?

(Complainant's counsel objects that the quotation from the exhibit refers expressly to a different product from that described by its chemical properties, and to which the witness has testified as being, in his opinion, a neutral lime-soap.)

A. If the whole of the last paragraph of that exhibit included between the words "the" and "it" be read, it will be seen that the question refers to another substance, namely, the "milky water," which, with Faraday, seems to have been the subject of his observations as described in the language which followed, and that that milky water is not the "scum" spoken of in an earlier paragraph of this exhibit, but, according to him, is water, holding in suspension what he terms an "altered fat."

527 X Q. 133. Exhibit 1 says: "The finely divided state of the substance, its solidity, and its near approach to the specific gravity of water, will perhaps account for the length of time during which it will remain uniformly diffused through it." Is this descriptive of the properties of a neutral lime-soap?

A. This is the property of a great many substances which remain suspended for a long time in water when they are very finely divided, are solid, and approach very nearly the specific gravity of water. I have not made that particular experiment with lime-soap under the precise circumstances wherein "unchanged fat and oil" had been also disseminated throughout the water, and had been by mechanical agitation most intimately blended; but I should presume that such a condition of milkiness as described would present itself under the circumstances named.

X Q. 134. Do you understand that it was the "milky water" that was "filtered through good filtering paper?"

A. In reading the entire paragraph to which I have alluded it is necessary to observe carefully the transitions which the author seemingly

makes from one substance to the other, and the meaning of the different sentences in that paragraph can only be comprehended when read with a knowledge of chemistry. In the first place, then, alcohol was made to dissolve all but dirt and mechanical impurities; then comes a totally distinct statement that "the softer portions from the surface of the water" (doubtless alluding to the "scum") "were found to contain a quantity of unchanged fat and oil." Then comes another and totally distinct sentence in its subject, wherein "the milky water" is alluded to, in which, as I now read it, he seems to mean to say that the unchanged fat and oil are found, while in the next sentence there might be some confusion as to his full meaning; he says: "It undergoes no change in appearance when left for many weeks." This, taken in context with the last sentence of the whole paragraph, would imply that the allusion was made to the milky water. He then says: "But when filtered through good filtering paper, the latter portions came through clear and transparent, the altered fat being separated." This would imply that he meant that it was the alcoholic solution alluded to in a sentence above, which, when allowed to stand and filtered, "came through clear and transparent, the altered fat being separated," an interpretation rendered more reasonable by reading what immediately follows, namely, "When
528 evaporated it leaves a substance having all the properties of the solid matter above described." The following are chemical facts which must be taken into account in reading these portions of the exhibit: First, that fat does not dissolve in water; second, that lime-soap does not to any extent dissolve in water; third, that fats, fat acids, and lime-soap do, in variable degrees, dissolve in hot alcohol; and, fourthly, that both oily fats and lime-soap are susceptible of mechanical suspension in water. These being true, the alcohol alluded to was able to dissolve, if present, a lime-soap. That the water was unable to dissolve the fat or fatty products, and that, therefore, when a substance is alluded to as attained from the evaporation of a clear liquid, it is evident from the context that alcohol holding a substance in solution was meant; and that the water which was milky was not the substance filtered from which an altered fat had been derived. Assuming that an author like Faraday, proverbial for his clearness of expression, would not make statements either inconsistent with chemical accuracy, nor liable to misconstruction, and assuming continuity of thought between his reference to the "milky water" and that wherein he says it undergoes no change in appearance when left for many weeks, but, when filtered through good filtering paper, the latter portions came through clear and transparent, the altered fat being separated, I cannot but think that a typographical error has been committed, wherein the word "altered" should have been "unaltered." Such a reading will harmonize and render intelligible the several statements of that paragraph.

X Q. 135. Will you now please state, having the original article from which Exhibit 1 is taken before you, whether or not, in your opinion, the "milky water" was the substance which was "filtered through good filtering paper?" Your answer is requested directly, and without reasons for the opinion which you may express.

A. It is impossible for me to say positively yes or no without qualification. If permitted to suspect a typographical error, as above indicated, I should answer that it was the milky water which was so filtered. If this supposition is not admitted, then there are reasons in the context below that it would imply that it was not the milky water which was so filtered.

X Q. 136. Is not "the milky water" referred to in the last paragraph

of Exhibit 1 the same water which issued from the end of the ejection-pipe, which "very much resembles thin milk," spoken of in the first paragraph of Exhibit 1?

A. It is not absolutely the same, as will be seen by reading the
529 paragraph commencing, "The water, as it issues from the end of the ejection-pipe." It will be seen that it states that the water "very much resembles thin milk," and that "a scum is found floating on it, which, when collected together," &c. (Now it is to be observed that the scum has separated from that which resembled thin milk, the scum having before separation contributed to make it resemble thin milk. After the separation of the scum, it is my understanding that the water would retain a milky appearance; but the milky water in quotation, specifically referred to in the last paragraph of Exhibit 1, was the water which had been passed through the engine only a moderate number of times; whereas, "after having been used for some time," it "very much resembled thin milk." This would explain why unchanged fat and oil are alluded to as contained in the milky liquid, while no allusion is made to the presence of unchanged fat or oil in the scum chemically examined.)

(That portion of the foregoing answer included in parenthesis objected to as being irresponsive and argumentative.)

X Q. 137. Assuming that it was the "milky water" spoken of in the last paragraph in Exhibit 1, "which was filtered through good filtering paper," two products are stated to have resulted from such filtration, are they not?

A. This would be my conclusion did I assume that the milky water was filtered through good filtering paper.

X Q. 138. And one of such products is stated in the exhibit to have been "the altered fat," is it not?

A. Those are the words as they appear in print.

X Q. 139. And you think the words should be "the unaltered fat?"

A. I do not say that I think the words should necessarily be "the unaltered fat;" but I say that the paragraph, from the words "the softer portion," &c., to the words "being separated," inclusive, would read more in harmony throughout from a chemical point of view by assuming that the word "altered" should be "unaltered." If, on the other hand, we cannot assume that error in print, then it is clear that the next sentence after the word "separated," to wit, "When evaporated it leaves a substance having all the properties of the solid matter above described," does not refer to a product derived from the milky water, but to the solution in alcohol referred to in the beginning of the paragraph.

X Q. 140. And would the solution in alcohol thus filtered
530 leave two products, one an "altered fat," and the other a substance which you have already stated to have been in your opinion a lime-soap?

(Complainant's counsel objects that witness has made no such statement in respect to the substance in question.)

A. Reverting once more to all the statements in this exhibit, made by Faraday, describing the properties of the substance he obtained, I would answer that that alcoholic solution would not, because, from a chemical view, it did not contain both altered fat and lime-soap, but only contained, so far as the fat was altered, a lime-soap proper.

X Q. 141. Do you now testify that the product of the filtration which is stated in Exhibit 1 to have been an "altered fat," was not in fact an altered fat or free fat acid; will you please answer yes or no?

A. I cannot answer yes or no categorically, without words of explanation, without being misunderstood, since in either case it would be a matter of interpretation of the language of Faraday, or an hypothesis, which would reconcile in each the statements of the paragraph containing the quotation in question.

X Q. 142. Are you able to say that it was not an altered fat or free fat acid?

A. I am not prepared to state that it was not an altered fat, since the paragraph containing it admits of this mode of interpretation of its various parts, which I have not heretofore given, to wit, that the softer portions from the surface of the water contain "a quantity of unchanged fat and oils." This does not imply that those portions were exclusively unchanged fat and oils, but implies there was something else present. Next, the milky water, on examination, was found to be a mixture probably of this substance and water. If by this substance is meant, as may be inferred, unchanged fat and oils and lime-soap, then down to this point the paragraph is intelligible. When filtered though good filtering paper, the water goes through clear and transparent, leaving upon the paper what is termed the altered fat, which, in this reading, would mean the unchanged fat and oil, altered or changed by having mixed with it lime-soap. Again, "when evaporated it leaves a substance having all the properties of the solid matter above described." If now the evaporation referred to is intended to apply to driving off the water from the milky water, then it is clear that the substance
531 left would be that having all the properties of the solid matter above described, namely, the softer portions containing a quantity of unchanged fat and oil and lime-soap. Read in this connection, the last sentence of the paragraph harmonizes with the preceding sentences, and the whole paragraph presents no unreconcilable features or expressions.

X Q. 143. Do you not know when you say that "the last sentence of the paragraph harmonizes with the preceding sentences," that the preceding sentences alluded to in your answer are not in said paragraph, but are in a preceding and separate paragraph? Please look at the book and answer.

A. During the earlier portion of the examination to which I have been subjected as witness to-day, I was shown only defendants' printed Exhibit 1, which seemed, by his counsel referring to it, to be accepted as that from which I should answer. In that exhibit, by the punctuation and distribution of the sentences, the whole subject of my answer upon which I am now questioned was contained in a single paragraph embraced between the words "the action of the alcohol" and the words "diffused through it," inclusive; while later to-day, during the examination, I have been shown volume 6, of the Quarterly Journal of Science, Literature, and the Arts, London, 1823, on page 173, the same in substance, differing a little in punctuation from that in Exhibit 1, wherein the paragraph from which I have quoted is divided into two paragraphs, one of which is embraced between the words "the action of the alcohol" and the words "contain a quantity of unchanged fat and oils," inclusive, and the other contained between the words "the milky water" and the words "diffused through it," inclusive.

X Q. 144. Taking the article as you now understand it, having read the original publication, you do not understand, do you, it to be stated that the "milky water" contained a quantity of unchanged fat and oil?

A. I understand according to this, which is but one of the interpretations given to the entire language, that the milky water does contain

some of what the author terms "softer portions," which softer portions "contain a quantity of unchanged fat and oil," and which softer portions may be inferred to contain, along with the unchanged fat and oil, lime-soap. By his saying that the softer portions "contain unchanged fat and oil," it implies that they were not the only substances. Had they been, he would have said that the softer portions consisted of, and not that they contained unchanged fat.

532 X Q. 145. Then you mean to testify that the "milky water," which was examined, contained no altered fat or free fat acids; is that so?

(Complainant's counsel objects that the question implies that the terms "altered fat" and "free fat acid" are synonymous, which is not shown and has not been alleged by witness.)

A. Adhering to the idea that we are referring to the interpretation which we have last assumed, I do not mean that the milky water did not contain any altered fat; on the contrary, I mean that it did contain altered fat, but that alteration was fat changed to some new condition, so far as being mixed with a portion of lime-soap, and I exclude from my supposition the presence of any free fat acid as necessary in the mind of Faraday when he called it an altered fat.

X Q. 146. Do you testify that the milky water did not contain free fat acids—the milky water spoken of in the last paragraph of the original article?

A. Not having seen nor experimented upon the milky water in question, it is impossible to testify from my own knowledge what it may have contained or what it was. But interpreting the language of Faraday, and comparing it with his experiments cited in the earlier part of the exhibit, I see no evidence whatever that it contained free fat acids; nor do I see that Faraday has himself named or alluded to free fat acids anywhere in this paragraph.

X Q. 147. Do you testify positively that that product of the filtration which is called "the altered fat" was a lime-soap, or a mixture of lime-soap and unaltered fat—that it was either or both?

A. Since the most of my answers in connection with this and the preceding paragraph have not been statements founded upon a personal examination of the products of the Perkins engine, but only intended to express what may be the different interpretations of the language of Faraday, I cannot, of course, make any positive declarations of my own as to its nature. Repeating that, giving one of the reasonable interpretations of his account in this paragraph and previous experiments, I infer it to have been a mixture of unchanged fat and lime-soap.

X Q. 148. The "previous experiments" referred to by you were made upon the scum floating on the top of the water, and not on the water itself; am I not correct?

A. They were.

X Q. 149. And may not the language contained in the last paragraph of said article commencing with the words "the milky
533 water," be reasonably interpreted consistently with the idea of the "altered fat" being a free fat acid?

A. If we had no chemical knowledge by which we could recognize and clearly distinguish free fat acid from lime-soap, and had Faraday not given, in his experiments upon the scum, an account of the properties which he found it to possess, and then had we been left simply to guess, we might have speculated upon the possibility of its being a free fat acid; but his not mentioning it as such leaves us without a reason for such a supposition.

X Q. 150. Do you not believe, with your present knowledge in this branch of science, that a mixture of Russia tallow and olive-oil as used in Perkins' engine, and subjected to the action of water and steam as employed in Perkins' engine, would be converted into free fat acid and solution of glycerine?

A. I think it altogether probable that such a conversion would take place, dependent upon the time, temperature, and pressure to which the material should be subjected to each other, provided that no lime be present to anticipate the action of the water upon the fatty matters named; but there having been lime, and there having, as I infer, been the production of lime-soap, my conclusion is that in that particular case of the Perkins engine there was not a production of free fat acid; and, as a further reason for this belief, we find that Faraday does not announce that he had found free fat acid, but only informs us that the substance obtained had a resemblance to the free fat acids of Chevreul.

X Q. 151. Was not Faraday an eminent chemist?

A. He was.

X Q. 152. And do you not think that he could readily have distinguished between free fat acid and neutral lime-soap?

A. Had the subject presented itself to his mind, so as to induce further inquiry, he could easily have resorted to the means of determining fully whether it was really free fat acid or not; but for what reason I cannot undertake to say, learned as he was, he seems not to have pursued the matter further than to recognize what he expresses as a resemblance to fat acids.

X Q. 153. Passing to Defendants' Exhibit No. 12, Scharling, I understand you to say that both free fat acids and solution of glycerine were the resulting products of said process; am I correct?

A. My answer is that I understand Scharling to have distilled neutral fat with superheated steam and produced fat acids, with neither acroleine nor sebacic acid; and that though he does not mention it as produced, I infer that glycerine was there.

534 X Q. 154. From what is mentioned, the fact of no mention being made of the production of glycerine is not an important circumstance, is it?

(Complainant's counsel objects that the question is vague and ambiguous.)

A. Whether it is important or not, and if important, how far so, depends upon the sense attached to the word in the question propounded. If informed of its particular reference, I will endeavor to answer accordingly.

X Q. 155. The omission is unimportant, is it not, in view of the fact that the inference is natural to any mind conversant with the subject-matter, that solution of glycerine as well as free fat acids was produced by Scharling's process?

A. It is unimportant at the present day, in view of the knowledge which we now have of the fact that when fats are decomposed and furnish fat acids, glycerine is also produced if the temperature be not high enough to decompose glycerine; but it would have been a very important fact, at any period antecedent to this knowledge, when glycerine would not at all have been necessarily inferred.

X Q. 156. At what time would the distinct announcement of the production of glycerine in Scharling's process have been deemed important?

A. It would have been interesting to science had it been announced

at a time when Chevreul was making his researches. It would have been interesting had it been announced before Tilghman made his discovery, since by it glycerine, a commercial article, might be supposed to be thus manufactured as well as the fat acid, which Scharling did announce.

X Q. 157. Do you think that the distinct announcement of the production of glycerine as well as of fat acid by Scharling's process, had it been made in said Exhibit No. 12, would have been an important circumstance or fact as connected with this suit?

(Complainant's counsel objects that the witness is asked a question beyond the province of a chemical expert.)

A. Since the question involves a pure supposition, I cannot undertake to answer it excepting by adding further suppositions, and therefore supposing that Scharling had announced the production of glycerine along with the free fat acids as a process of distillation, then I should regard it as having little, if any nearer, identity with Tilghman's process than as it now is.

535 X Q. 158. If it had been so distinctly announced, would you regard the subsequent announcement that water in liquid form at the same temperature would produce the same results as being a new, distinct, and independent chemical discovery?

A. No matter how distinctly announced, provided it had been stated that it was by the process of distillation, I would regard the subsequent announcement that water in liquid form at the same temperature and pressure would produce the same results as a new, distinct, and independent discovery.

X Q. 159. And yet in both processes the same product, to wit, free fat acids and glycerine, are the results by combination of the fat acids and glycerine respectively with the elements of water, are they not?

A. They are both the result of the combination of hydrogen and oxygen gases; in the one case derived from liquid water, and in the other case from water in the vaporous state. The fact that because the same elements are involved and the same products ensue in the two cases by no means proves that the processes by which the results are obtained are identical, for it is equally well known that in the process of saponification by any of the alkaline bases, the elements of water play a similar part and produce corresponding results.

X Q. 160. In Exhibit 12 it is stated "that the palm-oil by means of the steam passing through it attained a temperature of about 160° C.," (say 20° F.) Would not the steam be condensed and liquid water exist in conducting said process?

(Complainant's counsel objects, that the question tends to mislead the witness, inasmuch as it is stated in the next sentence of the exhibit that "the boiler was kept by means of a coal-fire at the same temperature.")

A. The steam at the temperature mentioned and under condition free to escape, the temperature of the boiler being maintained as stated in the exhibit, I do not understand how it was possible for the steam to be condensed and to remain in the boiler in the liquid state.

X Q. 161. Then you infer that the palm-oil did not attain the temperature named by means of the steam?

A. On the contrary, I do not see how it was possible to do otherwise than to attain the temperature of the steam which passed through it.

X Q. 162. Would not the steam be condensed until the palm-oil had attained the temperature of the steam?

536 A. The steam would be condensed until the palm-oil had at-

X Q. 150. Do you not believe, with your present knowledge in this branch of science, that a mixture of Russia tallow and olive-oil as used in Perkins' engine, and subjected to the action of water and steam as employed in Perkins' engine, would be converted into free fat acid and solution of glycerine?

A. I think it altogether probable that such a conversion would take place, dependent upon the time, temperature, and pressure to which the material should be subjected to each other, provided that no lime be present to anticipate the action of the water upon the fatty matters named; but there having been lime, and there having, as I infer, been the production of lime-soap, my conclusion is that in that particular case of the Perkins engine there was not a production of free fat acid; and, as a further reason for this belief, we find that Faraday does not announce that he had found free fat acid, but only informs us that the substance obtained had a resemblance to the free fat acids of Chevreul.

X Q. 151. Was not Faraday an eminent chemist?

A. He was.

X Q. 152. And do you not think that he could readily have distinguished between free fat acid and neutral lime-soap?

A. Had the subject presented itself to his mind, so as to induce further inquiry, he could easily have resorted to the means of determining fully whether it was really free fat acid or not; but for what reason I cannot undertake to say, learned as he was, he seems not to have pursued the matter further than to recognize what he expresses as a resemblance to fat acids.

X Q. 153. Passing to Defendants' Exhibit No. 12, Scharling, I understand you to say that both free fat acids and solution of glycerine were the resulting products of said process; am I correct?

A. My answer is that I understand Scharling to have distilled neutral fat with superheated steam and produced fat acids, with neither acroleine nor sebacic acid; and that though he does not mention it as produced, I infer that glycerine was there.

534 X Q. 154. From what is mentioned, the fact of no mention being made of the production of glycerine is not an important circumstance, is it?

(Complainant's counsel objects that the question is vague and ambiguous.)

A. Whether it is important or not, and if important, how far so, depends upon the sense attached to the word in the question propounded. If informed of its particular reference, I will endeavor to answer accordingly.

X Q. 155. The omission is unimportant, is it not, in view of the fact that the inference is natural to any mind conversant with the subject-matter, that solution of glycerine as well as free fat acids was produced by Scharling's process?

A. It is unimportant at the present day, in view of the knowledge which we now have of the fact that when fats are decomposed and furnish fat acids, glycerine is also produced if the temperature be not high enough to decompose glycerine; but it would have been a very important fact, at any period antecedent to this knowledge, when glycerine would not at all have been necessarily inferred.

X Q. 156. At what time would the distinct announcement of the production of glycerine in Scharling's process have been deemed important?

A. It would have been interesting to science had it been announced

at a time when Chevreul was making his researches. It would have been interesting had it been announced before Tilghman made his discovery, since by it glycerine, a commercial article, might be supposed to be thus manufactured as well as the fat acid, which Scharling did announce.

X Q. 157. Do you think that the distinct announcement of the production of glycerine as well as of fat acid by Scharling's process, had it been made in said Exhibit No. 12, would have been an important circumstance or fact as connected with this suit?

(Complainant's counsel objects that the witness is asked a question beyond the province of a chemical expert.)

A. Since the question involves a pure supposition, I cannot undertake to answer it excepting by adding further suppositions, and therefore supposing that Scharling had announced the production of glycerine along with the free-fat acids as a process of distillation, then I should regard it as having little, if any nearer, identity with Tilghman's process than as it now is.

535 X Q. 158. If it had been so distinctly announced, would you regard the subsequent announcement that water in liquid form at the same temperature would produce the same results as being a new, distinct, and independent chemical discovery?

A. No matter how distinctly announced, provided it had been stated that it was by the process of distillation, I would regard the subsequent announcement that water in liquid form at the same temperature and pressure would produce the same results as a new, distinct, and independent discovery.

X Q. 159. And yet in both processes the same product, to wit, free fat acids and glycerine, are the results by combination of the fat acids and glycerine respectively with the elements of water, are they not?

A. They are both the result of the combination of hydrogen and oxygen gases; in the one case derived from liquid water, and in the other case from water in the vaporous state. The fact that because the same elements are involved and the same products ensue in the two cases by no means proves that the processes by which the results are obtained are identical, for it is equally well known that in the process of saponification by any of the alkaline bases, the elements of water play a similar part and produce corresponding results.

X Q. 160. In Exhibit 12 it is stated "that the palm-oil by means of the steam passing through it attained a temperature of about 160° C.," (say 20° F.) Would not the steam be condensed and liquid water exist in conducting said process?

(Complainant's counsel objects, that the question tends to mislead the witness, inasmuch as it is stated in the next sentence of the exhibit that "the boiler was kept by means of a coal-fire at the same temperature.")

A. The steam at the temperature mentioned and under condition free to escape, the temperature of the boiler being maintained as stated in the exhibit, I do not understand how it was possible for the steam to be condensed and to remain in the boiler in the liquid state.

X Q. 161. Then you infer that the palm-oil did not attain the temperature named by means of the steam?

A. On the contrary, I do not see how it was possible to do otherwise than to attain the temperature of the steam which passed through it.

X Q. 162. Would not the steam be condensed until the palm-oil had attained the temperature of the steam?

536 A. The steam would be condensed until the palm-oil had at-

tained a temperature of 212° F.; so soon as a temperature beyond that was reached by the oil, there being no pressure to the boiler to confine the contents, the previously condensed water would now be converted into steam and all pass away, while all subsequently entering steam, as the oil should become hotter and hotter, would traverse the melted substance only in the condition of steam.

Examination adjourned to to-morrow (Tuesday) morning at 10 o'clock.

TUESDAY, *March 23d*, 10 *a. m.*

Present, B. C. Tilghman, esq., for complainant. Chas. B. Collier, esq., for defendants.

Cross-examination of Robert E. Rogers resumed.

X Q. 163. Turning to Defendants' Exhibit No. 17, Walther's patent, will you state what is the highest degree of heat and corresponding pressure contemplated by said letters-patent?

A. I find in Exhibit 17, Walther's patent, a statement that "the safety-valve B is closed and loaded by the weight C, at the rate of about what is called two atmospheres, so that the steam which is about to be admitted into the vessel A can only be accumulated therein, until it requires twice as much elastic force therein as the atmospheric air without, for after that the steam will be able to lift the safety-valve B and make its escape." The word "requires" in this quotation from exhibit appears to be a misprint, since in the copy of the English patent the word "acquires" is used. The highest degree of heat and pressure indicated by the words of the letters-patent are indicated by the mention of certain numbers of atmospheres, thus in the quotation above given two atmospheres are stated. This means that it is one atmosphere or fifteen pounds per square inch of force, which would tend to the bursting of the containing vessel. In this country and in Great Britain it is the habit of steam users to speak of fifteen pounds to the square inch as being one atmosphere, meaning that it is the bursting pressure. The French, on the other hand, taking account of the fact that steam of one atmospheric pressure must be within the boiler to balance the outer atmospheric pressure or the weight of the air, speak of two atmospheres within the boiler as meaning the same bursting force which we do when we allude to one atmosphere or
537 fifteen pounds to the square inch. Therefore, as in the quotation, where instead of two atmospheres we substract one, so in the latter part of the exhibit, wherein four atmospheres and five atmospheres are respectively spoken of, we must substract one atmosphere, and read the pressure accordingly as one, three, and four atmospheres respectively, fifteen, forty-five, and sixty pounds to the square inch, corresponding to 250° F. for fifteen pounds, 293° F. for forty-five pounds, and 308° F. for sixty pounds. These are the highest pressures and temperatures named in the exhibit.

X Q. 164. In your deposition given in the original suit against M. Werk, you were asked the following question, page 54, printed copy: "Question 59. In the process described in the Encyclopedia of Roret, page 114, in which saponification is produced as therein described, would the degree of heat then used, say 276°, produce a decomposition of the fatty substances by water alone, independent of the milk of lime, said to be used?" To which you answered as follows: "Were no milk of lime used in the process above alluded to, and water alone, at the temperature of 276°, a transformation into free fat acids and glycerine would take place; but since a full equivalent of lime was used in that

process, the saponification was accomplished through its instrumentality, being expedited by the high temperature employed." Is this still your opinion?

A. The answer which I gave at that time was given with a knowledge of Tilghman's process, and looking through the light of the knowledge of Tilghman's discovery, that water under high temperature and pressure is capable of decomposing fats into free fat acids and glycerine, my answsr is now what it was then.

X Q. 165. And does not Walther's patent contemplate a higher degree of pressure and temperature than the process as described in Roret?

A. It does, as seen in my answer to X Q. 163.

X Q. 166. And in the light of your present knowledge, without reference to the source of that knowledge, do you not believe that vegetable fats and oils, treated by the process of Walther, would be decomposed into fat acids and glycerine?

A. There are three interchangeable conditions involved in the production of free fat acids from fats by the action of water, namely, temperature and pressure, time, and mixture, and these may be said to stand in such relation to each other as that when one is diminished the others must be increased. Thus: if the temperature and pressure be high, and the mixture be maintained rapid and complete, the
538 time productive of the change is short; if, on the other hand, the temperature and pressure be low, and the mixture be imperfect, then the time will be long; therefore, I conclude, that while it is possible that by the process of Walther a decomposition may have taken place, yet it could only be done after a long subjection of the materials concerned to the action of the heated water; and since the process of Walther does not seem to indicate any great length of time, seven hours at most, in the whole process of heating from a single atmosphere, or fifteen pounds, to four atmospheres, or sixty pounds, I should doubt the decomposition to have been accomplished to any appreciable extent; a doubt confirmed, I think, by the absence of all reference to such a result in the patent of Walther, wherein he speaks of the oils being made more suitable for "burning in lamps, or for other useful purposes to which oil is commonly applied." This opinion, which I give, is entirely consistent with my answer above quoted by counsel for defendants in regard to the process in Roret, since it was as well known to me then as now that pressure and temperature, and time, and mixture were interchangeable conditions, and that if one was diminished the other should be increased.

X Q. 167. Calling your attention to the following paragraph from the Encyclopedia of Roret, to wit: "The boiler is then closed, and the liquid stirred at short intervals by raising and lowering the stirring rod or plunger. This operation is continued until the thermometer marks 277° F., (136 C.") I ask you whether in your opinion the patent of Walther does not contemplate a longer time than the process as described in Roret?

A. I find immediately following the quotation of the question the following words, to wit: "As the whole mass becomes stiff after a certain time, agitation is no longer practicable; the operation is left to itself and ceases with the diminution of the temperature. When the thermometer only shows 212° Fa'r., the boiler is opened and emptied by the man-hole as soon as it is sufficiently cooled." The only mention of time is contained in the above sentence, and it is so vague as to furnish me no means whatever of comparing the time involved in the two processes spoken of in the question.

X Q. 168. In Walther's process, would not the divided currents of steam agitate constantly the mixture?

A. I have no doubt that the currents of steam would agitate the mixture; but it appears to me simply as a matter of my own reflection
539 that that mixture would be rather one of steam and fat than of water and fat, though doubtless some water will be likewise blended with the fat.

X Q. 169. Is not a solution of lime-water used in said process?

A. By the statement in the patent papers lime-water is used, wherein oil is proposed to be improved in quality for burning in lamps, and other purposes.

X Q. 170. And the quantity of lime so contemplated was not sufficient to form a neutral lime-soap, with all the oil, was it?

A. It was not.

X Q. 171. Are you prepared to say, that if the process of Walther is practiced to-day upon vegetable fats and oils, using the highest temperature and pressure as contemplated in his said letters-patent, and in the manner described in said patent, that an appreciable amount of free fat acid and solution of glycerine will not be the resulting products?

A. With the light of my present knowledge of Tilghman's discovery, I am prepared to say, that if a sufficient length of time were allowed for the water to act on fats at the highest temperature and pressure named by Walther, I do not doubt that some chemical reaction of the water upon the fat would take place; but it would involve a long time, placing it, in my opinion, beyond the pale of a practical manufacturing operation. Since Walther's specification does not contemplate any such length of time, I see no reason for supposing that any appreciable production of fat acids and glycerine would take place in his specific process. Certainly, no quantity could be formed which would in any way attract attention or be of commercial interest.

X Q. 172. Then you think that a mixture of vegetable or animal oils placed in a digester, such as described by Walther, together with a saturated solution of lime-water, heated gradually to the highest temperature contemplated in said patent as designated by you, (to wit, 308° F.,) and for the longest time contemplated in said patent, "making up six or seven hours," the precise directions of the patent being pursued, that no appreciable amount of free fat acid and solution of glycerine would be produced? Is this your opinion? Will you answer directly, yes or no?

A. I answer directly, no; but to be understood, desire to explain. So far as the lime present is concerned, there will be glycerine set free and lime-soap produced. So far as the action of the steam and water on the fat is concerned, I do not believe that an appreciable decom-
540 position will ensue, since the patentee expressly states that the materials are heated gradually; by which statement it is clearly to be seen that the portion of the entire time named, in which the substances are at the higher temperature, is but a fraction of the entire time of six or seven hours.

X Q. 173. If your opinion as expressed is not correct, and if, on the contrary, there would be an appreciable amount of free fat acid and solution of glycerine produced, by what agency would they be produced?

A. I have not expressed any positive opinion as to the fact; but I have expressed my doubts and my opinion that there was a reason to doubt the production of an appreciable decomposition, (and have

already stated that I thought my doubt was confirmed by the fact that Walther has himself ignored the decomposition of fats into fat acids and glycerine in his process, and has, indeed, attempted by his process to obtain fats and oils in a condition of purity as suitable for special purposes, which, had they been fat acids, would have been unsuited to such uses. Oils, for instance, if turned into oleic acid, so far from being made better to be burned in lamps, would be greatly impaired in that application.)

(That portion of the foregoing answer contained within parenthesis objected to by defendants' counsel, as not being responsive to the question, and being argumentative.)

X Q. 174. If the doubts as expressed by you are incorrect, and if on the contrary there would be an appreciable amount of free fat acid and solution of glycerine produced in Walther's process, by what agency would they be produced?

A. If proof were given to me of the actual fact of their production, under precisely the circumstances of the process of Walther, then I should accept it as a fact, but should feel, notwithstanding, that my preceding statements have been correct, when I have referred to Walther as having been ignorant of such fact, and of Tilghman having been its discoverer.

(Preceding answer objected to as not being responsive to the question and argumentative, and question repeated.)

X Q. 175. X Q. 174 repeated.

A. It was my intention to add to the preceding answer, with a view of making it complete, that under such supposition, accepting the fact as proved, my interpretation would be, from the knowledge I now have of Tilghman's discovery, that it was through the action of the water that the production of free fat acids and solution of glycerine took place.

541 Examination adjourned to to-morrow (Wednesday) morning at 10 o'clock.

WEDNESDAY, *March 24th*—10 *a. m.*

Present, B. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

Cross-examination of Robert E. Rogers resumed:

X Q. 176. Calling your attention to the following paragraph and its context in Walther's patent, to wit, "But as the improvement of the purification of oil in this way is a matter of degree," &c., do you not think that in limiting Walther's patent to a temperature of 308° F. as a maximum, and to seven hours time, you have interpreted the patent much more strictly than you have interpreted the complainant's patent, when interrogated as to the minimum of heat and pressure contemplated in the complainant's patent?

A. Reading paragraph quoted, and taking it in context with what follows immediately, and then looking to the object contemplated in the entire patent, I do not think that I have interpreted Walther's patent more strictly for the attainment of its object than I have Tilghman's for the attainment of its object. Walther's purpose having been the purification of vegetable and animal oils, fats, &c., and having nowhere mentioned products of decomposition as consisting in the production of fat-acids and glycerine, it is evident to my mind that he designedly limited these points as practically attaining the sought-for results, and further,

was in a measure practically limited to that range, since had he either prolonged the time greatly beyond that at which the materials were kept at the temperatures and pressures named, or had he considerably increased those pressures and temperatures he would have obtained results not suited to his wishes—he would have obtained products not adapted as oil to burn in lamps, or for purposes of lubricating, or materials economically productive of soaps.

X Q. 177. Does not his patent contemplate in part the production of products more "suitable for soap-making" and "other useful purposes," as well as products "more suitable for burning in lamps?"

A. His patent does contemplate the production of products more suitable for soap-making and other useful purposes, as well as products more suitable for burning in lamps; but, as I understand his patent, by
542 the term more suitable he meant the purification of the oils and fats, by the removal of foreign matters such as the "most volatile and bad-smelling parts of the oils, fats or tallows," an expression often repeated in his specifications. His aim was to improve the quality of the oil or fat operated upon to adapt it the better to burning in lamps if oils, economically to produce soap if fats, and to burn better when made into the form of candles, but I see nowhere indicated that anything more was contemplated than purification. There could have been no commercial object to convert fats or tallow first into fat acids for purposes of soap-making, since it was well known that saponification was easily accomplishable by the action of alkalies upon fats or tallow directly. As I said before, were the oil changed to fat acids it would have been unsuitable either for lamps or machinery; and since the process is for oils, and fats, and tallows, described as common to all, it cannot be consistently supposed that the substance which is spoken of as improved for candles was the fat acids, but on the contrary a simple improved or purified quality of tallow.

X Q. 178. Passing now to Defendants' Exhibit No. 20, (Hirschfeld's patent,) two processes are therein described—one being for the decomposition of the tallow; am I not correct?

A. The exhibit, after naming the apparatus employed, begins as follows: "The tallow can now be rendered in two ways." One of these is described as accomplished by simply heating with water, or with dilute solution of sulphuric acid in water, in the digester, and the other in which he says, "if the tallow is to be decomposed at the same time," a larger amount of sulphuric acid in proportion is employed, and is similarly heated in the digester.

X Q. 179. Please look again at the exhibit and state whether there are not two processes spoken of for "rendering" the tallow, one in which water alone is used, and one in which "very dilute sulphuric acid of 1.006 specific gravity" is used; and whether there is not another process described for "decomposing" the tallow?

A. I read in the exhibit, under the heading "Translation," that a patent was granted to Hirschfeld for "Improvements in the manufacture of candles from pure or decomposed tallow." By the connection of the word "pure" with the word "decomposed" by the word "or," I understand the meaning of the expression to be that decomposed tallow means pure tallow. Reading, then, that to which my attention has been called by defendants' counsel in this question, I recognize that the object of the patent throughout is to purify tallow. Sometimes water alone is
543 sufficient to accomplish the result; sometimes he looks upon dilute sulphuric acid, of specific gravity 1.006, as better adapted to the purification, and again, a still stronger solution of sulphuric acid to

be advisable to obtain good results. Tallow in its raw or crude state contains very variable amounts of cellular membrane, blood and vascular tissue; now, when free from these nearly, I can understand why he uses only water, and why he needs a little sulphuric acid when they are more abundant, and why he recommends still more acid when these substances to be destroyed or dissolved are present in still larger amounts; but I conceive the aim and principle of the process is the same for all, to wit, the solution or destruction of the extraneous substances and the production of a purer fat, or what he terms "tallow" in one place, and "rendered, decomposed mass" in another place.

(Answer objected to as not being responsive to the question, and question repeated.)

X Q. 180. X Q. 179 repeated.

A. To be more specific in my answer with reference to the two paragraphs, the one commenced by the words, "The tallow can now be rendered in two ways," the other by the words, "But if the tallow is to be decomposed at the same time," I would state that I do not regard it as another process described, but regard all as having the same end in view. The word "decomposed," in the last paragraph is, I conceive, applied to the destruction of that considerable amount of tissue, &c., in raw or green tallow, wherein before the tallow could be rendered or purified thoroughly, this decomposition was necessary. But in the preceding paragraph, where rendering is spoken of, it assumes that the tallow is already more free from such foreign matters, not needing such decomposition. No pressure, no elevated temperature, no long period of time being mentioned, it does not appear that there are any agencies at work in this process which would decompose the tallow in the sense of converting it into free fat acids and glycerine. Therefore, taking all these considerations into account, I think that these different steps are intended to be varied according to the degree of purity of the original fat, and only for the purpose of obtaining a purified product.

X Q. 181. Then you think that the words "decomposed tallow" in the first paragraph of the patent, the words "but if the tallow is to be decomposed at the same time," in the fourth paragraph, and the
544 words "the decomposition can be *a* accomplished at the same time," in the last paragra*g*h, mean, that there is no decomposition of the tallow. Is this your interpretation, and will you answer directly yes or no?

A. In view of what I have already said, and in view of the language contained throughout the exhibit, my interpretation is that there is no decomposition of the tallow as tallow or fat proper into free fat acid and glycerine either expressed or implied by the language of said exhibit, and that the decomposition referred to is a destruction or solution of the foreign matters which rendered the crude tallow impure.

X Q. 182. And your testimony-in-chief upon this exhibit is based upon the interpretation which you have thus given to the patent, to wit, that there was no decomposition of the tallow proper; is that so?

A. The testimony given in-chief was based upon the interpretation above given, with the further understanding in my own mind, assuming, (which however is not stated or claimed in the exhibit,) that if any free fat acid had been produced in what has been termed the second process of exhibit, such production was the result of the action of the sulphuric acid upon the fatty substance proper, over and above its destruction of the cellular or other impurities of the crude tallow.

X Q. 183. Now, upon my interpretation of Hirschfeld's patent, to wit,

that three processes are therein described, one for rendering or purifying the tallow by means of water; another for rendering or purifying the tallow with "very dilute sulphuric acid of 1.006 specific gravity;" a third, for "decomposing" the tallow; will you please state whether if the tallow is entirely decomposed by the third process, the resulting products will not be a portion of sulpho-glycerine acid, and the remainder free fat acids and solution of glycerine?

A. If by the supposition of the question it is assumed that the whole of the tallow is decomposed in the process spoken of as the third, and the entire quantity of fat acid which it contains should be produced, then the sulphuric acid employed to the extent of its own power to act would doubtless form sulpho-glyceric acid, and there would be left in solution in water the balance of the glycerine which had not been attacked by the sulphuric acid, and the whole of the free fat acid of the tallow.

X Q. 184. And would not, upon the same hypothesis or interpre-
545 tation of the patent, as made by me, a portion of the free fat acid and solution of glycerine be produced by the agency of water in a close vessel under pressure?

A. If I am to answer from an assumption or hypothesis, and to reason solely from the statements or premises of that assumption or hypothesis, then I should say that by adding the supposition that the temperature and pressure of the process in question had been named as sufficiently high, the free fat acids and glycerine would be the result of the decomposing power of water upon fats.

(The counsel for the defendants states to the witness that he has a right to place an interpretation upon the language of the patent, and to ask the witness a question based upon such interpretation made by counsel. He further states that he has interpreted the patent as contemplating in the third process described in it a complete decomposition of the tallow, and upon such interpretation the witness is now requested to answer categorically the following question:

("X Q. 185. Would not, in the third process described in Hirschfeld's patent, if the tallow is entirely decomposed, a portion of free fat acid and solution of glycerine be produced by the agency of water in a close vessel under pressure?")

A. Not comprehending the meaning of the word "tallow" intended in the question, I would ask to be informed whether it refers to the fatty substance proper, from which fat acid and glycerine are derivable, or the crude substance from which pure tallow is ordinarily rendered.

(The witness is informed that by the word "tallow" is meant the fatty substance proper, from the decomposition of which free fat acid and solution of glycerine are obtained.)

X Q. 186. X Q. 185 repeated.

A. If I understand the question aright, in which it is assumed that fatty substance proper is used in connection with the water and sulphuric acid under circumstances of high temperature and pressure, and is entirely decomposed, then I say that a portion of fat acid and a solution of glycerine would be the result, as the action of the water in a close vessel under high temperature and pressure.

X Q. 187. And if my interpretation of the language of Hirschfeld's patent as given in X Q. 183, and not yours, is the correct interpretation, then Hirschfeld's patent is substantially the same as the complainant's, to the extent of the production of free fat acid and solution of glycerine in Hirschfeld's patent, is it not?

(Complainant's counsel objects that the question assumes that

546 Hirschfeld's patent describes a production of free fat acid and glycerine, which is not the fact; that it assumes that Hirschfeld's patent describes a high temperature and pressure, which is not the fact; that it assume' that Hirschfeld's product is not tallow, which it is expressly described to be; that witness is called upon to give an opinion upon a question of law, based upon assumptions contrary to the facts stated in the exhibit.)

A. Desiring to be understood as answering the question upon the hypothesis of defendants' counsel, and understanding that in that hypothesis or interpretation of Hirschfeld's process are included in his views all the conditions for the decomposition of fat proper by water under high temperature and pressure, then I should say that the two processes were alike in the production of free fat acid and glycerine by the agency of water at high temperature and pressure.

Examination adjourned to to-morrow (Thursday) morning at 10 o'clock.

THURSDAY, *March* 25—10 *a. m.*

Present, B. C. Tilghman, esq., for complainant; Cha's B. Collier, esq., for defendants.

Redirect examination of Robert E. Rogers:

Q. 188. Referring to Defendants' Exhibit 1, state whether it contains any proof that the "soft-solid" scum found on the water contained lime.

A. It being stated that this soft solid, when exposed long to the action of steam and at a high temperature yielded, when examined by Faraday, carbonate of lime, and it being stated that this softer portion from the surface of the water, before it had been hardened, contained "a quantity of unchanged fat and oil," implying that it contained something else, I regard it as a proof given that this soft-solid scum which was in a transition stage from completely fatty matter to complete lime-soap, contained both unchanged fat and lime-soap.

Q. 189. Explain by what tests or processes a chemist would ascertain the fact that a substance contained a quantity of unchanged fat and oil.

A. He would ascertain the fact by dissolving the substance in alcohol or in ether, and testing whether it was acid or not. If acid it could not be (that which gave the acidity) unchanged fat.

547 Q. 190. Does the use of the term "altered fat" in this exhibit necessarily or probably imply that the fat spoken of was a fat acid?

A. Interpreting the results obtained by his investigations of the substances the subject of this exhibit, I do not regard the term "altered fat" as either necessarily or probably implying the decomposition of fat into fat acid and glycerine; but, if it be a correct printing, it was meant to state that it was a fat which had in some manner undergone a change.

Q. 191. In your previous answers you have stated that lime-soap would dissolve in moderately-strong solution of potassa. Please explain how it dissolves and what products are formed.

A. Lime-soap dissolves in moderately-strong solutions of potassa by the application of moderate heat in the following way: The potassa decomposes the lime-soap, combines with the fat acid of the soap, and sets free the lime, which, being not soluble in the potash-soap, remains suspended throughout the liquid, giving it a turbid appearance, the potash-soap remaining in solution in the water which had contained the potash.

Q. 192. Explain how neutral fats dissolve in solution of potassa, and what products are formed.

A. Neutral fats are dissolved in solution of potassa in the following manner: The potassa combines with the fat acid and forms a potassa-soap, liberating the glycerine, which, with the potassa-soap remains dissolved in the water, the whole forming a clear solution.

Q. 193. I understand you to say that both lime-soap and neutral fat are dissolved in solution of potassa in the same way, that is, by decomposition, forming on the one hand a soluble soap, and, on the other hand, either insoluble lime or soluble glycerine. Is that correct?

A. It is so. They dissolve in the same way, in a chemical sense. The only difference between the two in the results is that the separated lime in the case of the lime-soap decomposition is not soluble in the remaining menstruum, while the glycerine in the case of the fat decomposition is soluble in its menstruum.

Q. 194. Referring to Defendants' Exhibit 12, Scharling states that he found no sebacic acid in the water distilled over with the fat acid. Please explain how a chemist would ascertain whether water contained sebacic acid.

A. Sebacic acid is soluble in hot water and not soluble in cold
548 water. He would therefore apply hot water, and maintain the heat to the distilate. If sebacic acid were present it would be taken up by the hot water. Upon allowing it to cool, and especially upon concentration, he would obtain the crystals of sebacic acid.

Q. 195. To ascertain the fact that "not the slightest trace" of sebacic acid was present, would not an evaporation of the water treated down to a single drop be necessary?

A. That would be the only proper mode of determining the fact.

Q. 196. If any glycerine were present in said water, would not its presence be made manifest in the treatment and evaporation you have described?

A. It would.

Q. 197. In defendants' process as described in their answers, does the superheated steam thrown into their digester remain in its superheated condition after it has come in contact with the heated water in said digester, or does it give off its surplus or superheat to the heated water, and thereby become itself converted into common steam?

A. In virtue of the tendency of all bodies, when heated, to assume an equilibrium of temperature among themselves, and in consequence of the presence of water in defendants' apparatus in contact with or under the influence of the steam, it is impossible for the superheated steam to retain its original amount of heat, but it gives out a portion of that heat to the water, converting that liquid into steam itself, when a condition will be reached in which both the original superheated steam, the newly-formed steam, the water, and other contents of the vessel, will be all brought to a uniform temperature corresponding to the pressure to which the safety-valve shall be loaded.

Q. 198. Then, in defendants' processes, superheated steam does not come into contact with the fat in the same sense or manner in which it does in Scharlings's or Dubrunfaut's process. Is that so?

A. It is so, from the fact that in Scharling's and Dubrunfaut's processes the steam is allowed to pass away unrestrained by pressure, the fatty matter being thereby distilled and carried off, and there being no water confined in the vessel to participate in robbing the superheated steam of its superheat by being converted itself into steam.

Q. 199. Referring to the hastening effect spoken of by Mr. Ropes as

being produced by his use of one-half per cent. of lime, and sup-
549 posing that by defendants' use of four per cent. of lime, $\frac{4}{10}$ of their fat is converted into lime-soap, and that the conversion of the remaining $\frac{6}{10}$ of their fat into fat acid by the action of the water is also hastened, will you please state whether this hastening action in any way increases or diminishes the quantity of lime and sulphuric acid saved or economized in the conversion of said $\frac{6}{10}$ of the fat into fat acids by the action of the water.

A. The question of the time consumed in the process has nothing to do with the quantity of lime employed, since that quantity is definitely prescribed and used up, whether it be accomplished in a short or a long time, and since the amount of sulphuric acid needed for the neutralization of that specified amount of lime must be always the same in amount as the chemical equivalent, it is evident that whatever may be the time or the amount of labor and fuel expended, the quantity of the chemicals, lime and sulphuric acid, must remain unaltered.

Q. 200. Referring to your statement, that some of the stearic acid of commerce contains a minute trace of lime; please state whether the said stearic acid is perceptibly altered in its properties of—1, solubility in ether; 2, solubility in alcohol; 3, fusing point, by the trace of lime so contained in it.

A. The presence of the minute trace of lime found in the stearic acid of commerce, made from lime soap, has been found not to alter it in the properties named.

Q. 201. Is said stearic acid made into candles and burned with this trace of lime still remaining in it?

A. It is.

Q. 202. Is this trace of lime only that which escapes the action of the sulphuric acid used to decompose the lime-soap from which the stearic acid is manufactured?

A. I cannot see how it could be present but from such cause.

Q. 203. How long has it been known, and by whom was it first announced as a chemical principle or theory, that fats in the act of being converted into fat acids and glycerine took up or combined with the elements of water?

A. It was first announced as a chemical principle or theory that fats in the act of being converted into fat acids and glycerine took up or combined with the elements of water, by Chevreul, more than forty years ago, and has remained accepted since that time by chemists generally.

Q. 204. Seven processes of converting fats into fat acids have been referred to in this investigation—five of them in defendants'
550 exhibits, and two in complainant's exhibits, to wit: 1, the alkaline saponification of Chevreul; 2, the distillation by heat alone, without steam, of Bussy & Lecann; 3, the distillation with superheated steam of Dubrunfaut; 4, the sulphuric saponification of Fremy; 5, the distillation by superheated steam of Scharling; 6, the decomposition by water of Tilghman; 7, the distillation of both fat acids and glycerine of Wilson & Payne. Please state whether in any of these processes the chemical principle announced by Chevreul is involved, to wit, that the elements of the fat acid and glycerine (wherever glycerine is produced) take up or combine with the elements of water.

A. The chemical principle announced by Chevreul, to wit, that the elements of the fat acid and of glycerine take up or combine with the elements of water, prevails in all of those instances wherein both the fat acids and glycerine are produced; while in those processes wherein

the fat acids are produced, but the glycerine decomposed, it is the glycerine which yields the elements of water to render complete the production of the fat acids from the fat.

Q. 205. Did the discovery and announcement by Chevreul of said chemical principle, more than forty years ago, make known to the public any or all of the six last-named processes, or were they discovered and published by different persons, and at different times, during said forty years?

A. The discovery and announcement by Chevreul of this chemical principle did not, in my opinion, make known to the public any of the six last-named processes; on the contrary, they were discovered, I believe, and published by different persons, and at different times, during said forty years.

Q. 206. In the decomposition of common cooking salt into soda and muriatic acid, is not this same chemical principle involved, to wit, the taking up or combining of the elements of water with the elements of the salt, and has not this been long known?

A. The same chemical principle is involved, namely, the taking up or combining of the elements of water with those of the salt, and it has been known for a long period.

Q. 207. Is any practical and economical process known to chemists, by which common salt can be made to take up or combine with directly the elements of water, so as to produce soda and muriatic acid?

(Objected to, for the reason that this case does not involve the decomposition of salt, but of fats.)

551 A. The practical and economical manufacture of soda-ash and of carbonate of soda, which is conducted on a scale producing thousands upon thousands of tons annually, depends upon the chemical reaction, by which the elements of common salt are made to take up or combine with the elements of water in the production of muriatic acid, and of soda in a state of sulphate of soda.

Q. 208. In the chemical arts are not several hundred thousand tons of lime and sulphuric acid annually consumed for the sole purpose of compelling the elements of common salt to take up and combine with the elements of water, so as to form soda and muriatic acid?

(Same objection as to preceding question.)

A. There are.

Q. 209. If to-morrow a person should discover a practical method of compelling the elements of common salt to take up or combine with the elements of water so as to form soda and muriatic acid by any direct process, say, by heating the salt and water in a close vessel to a high temperature and pressure, would or would not such a process be regarded as a chemical fact or discovery, and would it be of any interest or value?

(Same objection as to preceding question.)

A. The discovery of such a practical process would be looked upon as one of startling novelty and scientific interest, and would be hailed as inaugurating a new era in the manufacture of a variety of products depending upon the use of soda. The process would be, all the world over, estimated as of incalculable value.

Q. 210. Has it not been long known to chemists that alcohol could be produced by causing the kind of coal-gas, called olefiant gas, to take up or combine with the elements of water, and also that this result could be effected by an elaborate and expensive process by the use of sulphuric acid?

(Same objection.

A. Such has been known for some years, especially since the observations of Berthelot.

Q. 211. If a person should to-morrow discover that by heating coal-gas, with water in a close vessel to a high temperature and pressure, he could cause it to take up or combine with the elements of water, so as to form alcohol, would or would not such a process be regarded as a new chemical fact or discovery?

(Same objection.)

A. Such a process would undoubtedly be regarded as a new chemical fact and discovery.

552 Q. 212. Are there not numerous other important changes or decompositions of substances in chemistry and the chemical arts, in which it is known that this same chemical principle is involved, (to wit, the taking up or parting with the elements of water by the elements of the substance,) and which decompositions, nevertheless, in the present state of our knowledge, require elaborate and expensive processes, and the consumption of costly chemical agents, to compel this taking up or parting with the elements of water by the elements of the substances?

(Same objection as to preceding question, and as being mere matter of argument.)

A. There are numerous other such important changes or decompositions of substances in chemistry and the chemical arts, wherein this principle is involved, by which indirectly, or by what might be termed a round-about course, the elements of water are made to be either assumed or parted with, through the consumption often of large quantities of costly chemical agents.

Recross-examination of Robert E. Rogers:

X Q. 213. In your re-examination by complainant's counsel in answer to Q. 203, you say, "It was first announced as a chemical principle or theory, that fats in the act of being converted into fat acids and glycerine, took up or combined with the elements of water, by Chevreul, more than forty years ago, and has remained accepted since that time by chemists generally." In making such announcement, did Chevreul state any temperature at which such combination took place?

A. Not having the publications by Chevreul at hand, I cannot state that he named any special temperatures at which the process of saponification of fats by alkalies would take place; but I am under the impression that he looked upon it as a result which would occur very slowly when the alkaline solution was intimately mingled with the fat, and maintained at common temperatures, and that it would take place more and more rapidly as the materials were raised in temperature to the boiling-point. The chemical reaction between the alkali, the elements of the water, and the fat present, being the same in each.

X Q. 214. Then you mean, do you not, that it was announced by Chevreul that in the formation, not of "fat acids and glycerine," but of alkaline or neutral soap and glycerine, the reaction or combination of the water upon the fats took place?

553 A. As I understand Chevreul's view and announcement, he "taught us, (in the language of Morfitt's Chemistry, 1846, page 163,) the composition of fats, and showed us that the stearine, margarine, and oleine they contained are not free and uncombined bodies, as was supposed, but positive compounds, each of its respective acid with a peculiar base, glycerine, which the discoverer called the sweet principle of fat. Hog's lard, according to this chemist, embraces each of these

components, as incapable of direct combination with the alkalies, or to speak technically, of saponification, but acquires the facility by the presence of water, which it was supposed occasioned a change proportional to its elements, converting the stearine, margarine, and oleine into new bodies, which, from their acquired acid properties, were called adipose or saponic acids; the peculiar unsaponifiable body, glycerine, above named, being left behind as an incidental product." Such is my interpretation also of the chemical view entertained and taught by Chevreul.

X Q. 215. Then do you mean to be understood as saying that it was announced by Chevreul, and has been an accepted fact since such announcement, that fats, by the direct action of water upon them, would be converted directly into fat acids and glycerine?

A. I do not mean to be understood to say that Chevreul announced any such fact. His announcement, to which I have referred, has reference to the process of saponification, wherein fats are treated with alkaline bases and water. He has not anywhere, to my knowledge, announced that water, per se, had any such action upon fats.

X Q. 216. Who, so far as is developed by the exhibits of defendants in this case, prior to complainant's patent, produced, in your opinion, free fat acid and solution of glycerine directly by causing the elements of water to combine with the elements of glycerine and fat acids in fats without the agency of any alkaline base?

A. I have not been able to see announced or implied in any of the exhibits, any statement of the production of fat acids and glycerine from fat by the direct action of water, without the agency of alkaline bases, prior to the discovery of Tilghman.

X Q. 217. Did not Scharling, in 1850, (Defendants' Exhibit 12) produce free fat acids, and does he not so announce? Will you answer yes or no?

A. His process refers to the obtaining of free fat acids from
554 palm-oil. He did obtain such free fat acids by the process of distillation.

X Q. 218. And in the obtaining of such free fat acids by Scharling, did not the elements of water combine with the elements of free fat acids so as to form free fat acids, such combination taking place without the agency of any alkaline base?

A. It is by no means clear, from the language of Scharling in the exhibit, that any free fat acids were at all produced, since palm-oil contains free fat acid already in large quantity in its common crude state. In such case, the superheated steam would simply carry over the pre-existing fat acid. But supposing that a portion of fat acid was really produced by the action of the steam, wherein the elements of water combined with the elements of the free fat acid, it is evident that the action took place while the water was in the vaporous state, and not as liquid water. To be more specific with reference to the middle part of the question, the elements of water, provided they acted chemically at all, did, I have no doubt, combine with the elements of the free fat acids while in the condition of vapor, and not of liquid water, to form free fat acids.

X Q. 219. Do you not believe, as a chemist, (with Exhibit No. 12 before you,) that Scharling, in 1850, by the process described in said exhibit, and in the treatment by him of "palm-oil," castor-oil, and tallow, obtained both free fat acids and solution of glycerine?

A. Taking his language as referring to the "treatment of castor-oil in a similar way," and to the treatment of tallow with superheated steam," I do not doubt that by the process of distillation he obtained fat acids:

but whether he obtained glycerine from these substances by his method, I cannot say from anything which he states, though I think it not impossible that a portion of glycerine may have gone over also.

X Q. 220. Quoting the following paragraph from the description of Scharling's process in Exhibit 12, to-wit, "in all these distillations there was not the slightest trace of acroleine compounds remarked, (observed), and I have found no more of pyroleic acid or sebacic acid in the water distilled over;" I ask if you do not infer that glycerine was not destroyed, but was obtained in solution together with free fat acids?

A. Supposing that he made special examination for pyroleic and sebacic acid, and determined their absence, it is remarkable that if the glycerine was in the water, he has not mentioned the fact.

555 Had that whole paragraph been absent from the exhibit, I should have been led more likely to infer the presence of glycerine from my own reflections on the subject; still I think, as I would repeat, that it is altogether possible, simultaneous with the production of the fat acid by this process of distillation, there was also the production of glycerine.

X Q. 221. Is not the statement as made by Scharling that "there was not the slightest trace of acroleine compounds remarked," evidence that glycerine was not destsoyed, but was obtained?

A. The absence of acroleine would not prove the antecedent presence of glycerine, but it would only prove, if we assume that glycerine had been formed, that it had not been decomposed into acroleine. Therefore his statement goes no further than announce the fact of the total absence of acroleine.

X Q. 222. Would not the production or obtaining of free fat acids as announced, and the announcement that "there was not the slightest trace of acroleine compounds remarked," prove that glycerine was not destroyed, but was produced with the free fat acids?

A. It would be a proof that glycerine had not been destroyed, but it would not be a proof that glycerine had been there: its existence cotemporaneous with free fat acid could only be, but still might be, a matter of inference.

X Q. 223. Was not glycerine an element of the fats from which Scharling obtained his free fat acids?

A. In his use of the term glycerides, I infer that he contemplated the treatment of fats yielding glycerine on saponification.

X Q. 224. In your testimony in the suit of Tilghman vs. Mitchell, Q. 29, page 89, print, you were asked, "Please state whether by the distillation you refer to in your last answer as producing acroleine, you mean those performed by Scharling as stated by you, or the similar experiment performed at higher temperatures by Dubrunfaut." To which you answer'd, "In consequence of the names Dubrunfaut and Scharling having been associated in questions and answers which I have heard to-day, I have represented the results to be expected in Dubrunfaut's experiments as those belonging to Scharling; while in fact since Scharling's experiments were made at only 320° F., the decomposition of glycerine and the production of acroleine would not take place." Is this still your opinion?

A. Such is still my opinion.

X Q. 225. And Dubrunfaut's process differed from Scharling's,

556 did it not, in the particular that Dubrunfaut heated the fats to a very high degree, say 600° F., by the action of fire, before the introduction of the current of vapor?

A. I see it stated in the extract from Dubrunfaut's patent, printed as

an exhibit in the case of Tilghman vs. Mitchell, page 228, as follows: "All the fatty bodies previously heated to the temperature which we have indicated as the temperature of disinfection, that is to say, to 330° Cent., about, placed in a current of vapor of water heated to from 200° to 330° cent., furnish all their fatty acids without producing carburetted hydrogen." From this sentence I infer that there was either extraneous heat applied, or that such heating was accomplished previously by highly-heated steam.

R. E. ROGERS.

Sworn March 16th, and subscribed before me this 25th day of March, A. D. 1869.

WM B. DAYTON,
Special Examiner and Notary Public.

557 Counsel for complainant here offers in evidence:

1. The answer of Michael Werk in the suit of of Richard A. Tilghman vs. Michael Werk, in the circuit court of the United States for the southern district of Ohio, sworn to January 6th, 1860, as contained on pages 8 to 11, inclusive, of the printed record in said suit.

2. The correspondence of said Michael Werk with the Patent-Office, and the patent issued to said Werk, dated 5th October, 1858, as contained on pages 11 to 17, inclusive, of said printed record.

3. Pelouze and Fremy's Chemistry. Paris. 1850. Vol. 3d, pages 570, 571.

4. English patent to Gwynne & Wilson, No. 9944, Nov. 16, 1843.

5. English patent to Gwynne & Wilson, No. 10000, Dec. 28, 1843.

6. English patent to Gwynne & Wilson, No. 10191, 1844.

7. English patent to Wilson & Payne, No. 1624, July 24, 1854.

8. Journal of Society of Arts. London. Vol. 3, pp. 729 to 731.

9. Journal of Society of Arts. London, January 25, 1856, pages 148, to 150.

10. English patent to G. F. Wilson, No. 803, March 28, 1860.

The above, numbered 4 to 10, inclusive, are contained in complainant's printed record in the suit of Richard A. Tilghman vs. Roland G. Mitchell, pages 117 to 136, inclusive.

11. English patent to Melsens, No. 2666, 18th December, 1854.

12. English patent to De Milly, No. 2740, 19th November, 1856.

13. Thenard's Chemistry. Paris, 1835. Vol. 4, pages 154, 155.

14. Dumas' Chemistry, Paris, 1835. Vol. 5, pages 241, 262, 268, 271; and vol. 6, pages 569, 576, 577, 708.

15. Berzelius' Chemistry. Paris, 1850. Vol. 6, pages 441, 500, 511, 512.

16. Regnault's Chemistry. Paris, 1850. Vol. 4, page 806.

17. Payen's Chimie. Paris, 1851. Pages 747 to 766 inclusive.

18. Faraday's Chemical History of a Candle. New York, 1861. Pages 12 to 14.

19. Morfit's Chemistry. Philadelphia, 1847. Pages 76, 113, 114, 162 to 165, 325 to 347, 363 to 365, 426 to 452, all inclusive.

20. Engineering. London, 1857, May 24. Page 526.

21. Report of Juries, London Exhibition, 1851. Pages 616 to 630.

22. Report of Juries, London Exhibition, 1863, class 4, sect. A. Pages 3, 5, and 7.

23. Roret's Encyclopedia. Paris, 1849. Pages 10, 16, 82, 93, 120.

24. Chevreul, Recherches Chimiques. Paris, 1823. Pages 24, 25, 61, 71, 77, 179, 344, 346, 426.

558 25. Richardson and Watts' Chemistry. London. Vol. 1, part 3, page 751.

26. Muspratt's Chemistry. London. Vol. 2, page 252.

27. Watts' Dictionary of Chemistry. London, 1864. Vol. 2, page 886; vol. 4, page 192.

28. Storer's Dictionary of Solubilities. Cambridge, 1864. Pages 353, 416, 562.

29. Gmelin's Chemistry. London, 1865. Vol. 17, page 70; vol. 16, page 360; vol. 9, page 487.

30. The books named by Professor Booth in his answers to questions 68, 69, and 70 of his examination-in-chief in this suit, pages 120, 121, complainant's printed record.

31. French patent to Dubrunfaut, 28th August, 1841. Certificates of invention. Paris, 1857. Vol. 8, pages 330 to 340.

32. United States patent to Wright and Fouché, No. 22765, 25th January, 1859.

33. Correspondence of Wright and Fouché with Patent-Office.

As said No. 32 is contained on pages 220 to 225 of defendant's printed record in said suit of Tilghman vs. Mitchell, and said No. 33 is contained on pages 110 to 113, complainant's printed record in said suit, the counsel for defendants objects to the proposed introduction by the complainant of the answer of Michael Werk in the suit against him by Richard A. Tilghman, and to the correspondence of said Werk with the Patent-Office, and to letters-patent of said M. Werk, for the following reasons: that if the record of said cause is competent at all, the entire record should be introduced; again, said answer and correspondence and letters-patent are in no manner binding, competent, or operative as against the defendants to this suit.

And as to all the rest of the proposed documentary testimony, numbered from 3 to 33, both inclusive, the same is objected to for the reasons that it is irrelevant and incompetent, and in so far as it may have any bearing upon the questions involved in this cause, it is in the way of argument, and as such can be used or referred to at the hearing of said cause, and should not be spread upon the record.

Whereupon this examination was adjourned sine die.

559 United States circuit court, southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz. } 1018.

Agreement.

James C. Booth, having been recalled by the counsel for complainant, and J. E. Mathewson having also been called, it is hereby agreed that the examination of said witnesses shall proceed in the absence of the examiner, and that, after their testimony shall have been concluded, the same shall be placed in the hands of the printer, as has been done with the testimony heretofore taken, and, when printed, the original shall be forwarded to the court, all exceptions to the manner of taking such testimony being waived, and it being agreed that the same is to be used at the hearing, the same as if regularly taken and transmitted.

B. C. TILGHMAN,
Counsel for Complainant.
CHARLES B. COLLIER,
Counsel for Defendants.

PHILADELPHIA, *September 7th*, 1869.

560 SEPTEMBER 7TH, 1869.

JAMES C. BOOTH, a witness on the part of complainant, recalled, says:

Q. 506. Referring to your answers to X Q. 238 and 239, please state whether you have tried the experiment to ascertain whether water, at the temperature of 350° F., will decompose neutral lime-soap. If so, describe said experiment and its result, and state whether you have before testified thereto.

A. At the moment of answering those questions I forgot an experiment which I made in conjunction with Dr. F. A. Genth, in my laboratory, on the 16th of August, 1860, and which is cited in my testimony in the case of Richard A. Tilghman vs. Michael Werk, (page 75, complainant's printed testimony,) on the 4th of September, 1860. I then heated neutral lime-soap with water, in a close vessel, at a temperature of 350° F., during six hours, and upon examining the products after the experiment, I found that the lime-soap was wholly unchanged, and still remained neutral lime-soap.

Q. 507. Referring to defendant's exhibit, Pelouze's paper, Comptes Rendues, state whether the theory of M. Pelouze therein set forth, "that it is understood that water, at a temperature of 150° to 160° C., (302 to 320° F.,) can decompose a neutral soap into an acid soap and a very basic soap;" is it or is it not contradicted and disproved by your experiment?

A. It is wholly contradicted by my experiment.

Cross-examined by C. B. Collier, esq., for defendants:

X Q. 508. In the experiment referred to by you, the examination of the lime-soap was made after it had been withdrawn from the digester, and, of course, after the heat had been withdrawn from it; was it not so?

A. It was.

X Q. 509. Were the conditions of the materials in your experiment the same as in the experiment of Pelouze, from which his said theory is adduced?

A. In my experiment, neutral lime-soap and water were alone employed, without the use of fat or oil; so that the fact of the split-
561 ting of neutral lime-soap into an acid and a very basic soap by the action of highly-heated water, could be determined with precision without interference from any other substance.

X Q. 510. Do you think, and are you willing to testify as a chemist, that your experiment, in which you heated lime-soap together with water, (no neutral fat being present,) proves that lime-soap, heated together with water and neutral fat, will not be decomposed into an acid and very basic soap, as stated by Pelouze?

A. My experiment proves conclusively that neutral lime-soap cannot be decomposed by water at a high temperature and pressure into an acid soap and a very basic soap, which is the only conclusion of M. Pelouze, without mentioning neutral fat being present. My experiment, in conjunction with the fact that no other than a neutral lime-soap is known or recognized by chemists, proves that in M. Pelouze's experiment with neutral lime-soap and neutral fat, no decomposition of neutral lime-soap could have taken place into an acid soap and a very basic soap.

X Q. 511. Having heated neutral lime-soap and water without the presence of neutral fat, you are ready to testify, and do testify, that it is conclusively proved that neutral lime-soap heated with water, (neu-

tral fat being present,) the lime-soap will not be decomposed into an acid soap and a basic soap, as stated by Pelouze; is that so?

A. That is my firm conviction, on the grounds stated in my last answer.

X Q. 512. The problem which you undertook to solve by your experiment was, whether or not neutral lime-soap, heated with water in a close vessel to about 350° F. would be decomposed into a neutral soap and a basic soap; is not that so?

A. It is so.

X Q. 513. If such decomposition took place, it would be under the influence of heat, would it not?

A. I cannot theorize against facts.

X Q. 514. And you are of opinion that the examination by you of the neutral lime-soap in your experiment, after the heat had been withdrawn from it, and its removal from the digester, conclusively proves that when the heat was applied to it in the digester, it remained an unchanged neutral lime-soap; is that so?

A. I could draw no other conclusion from the facts.

562 X Q. 515. And you are also of opinion that the examination by you of the neutral lime-soap, after the heat had been withdrawn from it, conclusively proves that a neutral lime-soap, when heated in a digester with water and in the presence of a neutral fat, as in Pelouze's experiment, would not be decomposed into an acid soap and a basic soap as stated by Pelouze?

A. As stated in answer to X Q. 520, my experiment, in conjunction with the fact that no such thing as an acid lime-soap or a basic lime-soap is known or recognized by chemists, conclusively proves to me that, even in the presence of neutral fat and highly-heated water, neutral lime-soap cannot be decomposed into an acid lime-soap and a very basic soap. Pelouze does not state that lime-soap is so decomposed in the presence of neutral fat.

X Q. 516. Does not Pelouze state that in the supposed decomposition of the lime-soap, it (the lime-soap, after its decomposition) "acts secondarily upon a new quantity of fatty matter?"

A. He does not so state it; but he states in his assumed decomposition of neutral soap into acid soap and a very basic soap, that the basic soap acts secondarily upon a new quantity of the fatty matter.

X Q. 517. Then, during Pelouze's experiment, when the supposed decomposition of the lime-soap took place, a neutral fatty matter was present, was it not?

A. It was.

X Q. 518. If to-day you were called upon to ascertain whether or not a neutral lime-soap would be decomposed into an acid and a basic soap by the action of water heated in the presence of neutral fat, to a temperature of 150° to 160° C., would you simply heat the lime-soap with water and without neutral fat, and then allow it to cool down, before making your examination of it?

A. I would first try the experiment without neutral fat, and then afterwards I would try it with the presence of neutral fat. I would also refer to chemical works to ascertain whether an acid or a basic lime-soap was known or recognized by chemists. If I found that neutral lime-soap was not resolved by water into an acid and a basic soap, and that neither an acid nor a basic lime-soap was known to or recognized by chemists, and yet if, upon the addition of neutral fat with neutral lime-soap, I should find any other change in the resulting
563 products than neutral lime-soap and neutral fat, I still could not

possibly infer that the neutral lime-soap was resolved into an acid and basic soap, which last I could not find—either by experiment or research—to have any acknowledged existence.

X Q. 519. Why, after having tried the experiment with water and without neutral fat, would you try the other experiment with both water and neutral fat?

A. Because X Q. 518 requires it.

X Q. 520. Would you not rather make such second experiment because an experiment with water and lime-soap alone would not enable you to decide, as a chemist, whether or not lime-soap, heated with water and neutral fat, would be decomposed into an acid and a basic soap?

A. Being satisfied, from research and my own experiments, that neither an acid nor a basic lime-soap exists, I certainly would not endeavor to ascertain their existence by the use of neutral fat in addition.

X Q. 521. In answer to X Q. 518 you say, "I would first try the experiment without neutral fat, and then afterwards I would try it with the presence of neutral fat." In your last answer you say, "I certainly would not endeavor to ascertain their existence by the use of neutral fat in addition." Now you are again asked what you would do, if to-day you were called upon to ascertain, by experiment, whether or not the decomposition of a neutral lime-soap into an acid and a basic soap would take place as supposed by Pelouze.

(Question objected to, as stating that the witness is to be called upon to-day to ascertain, by experiment, the correctness of Pelouze's statement, and thereby excluding the results of his previous knowledge derived from chemical examinations (testified to herein) of the products of experiments made by heating together fat, lime, and water, (defendant's products of 1860 and 1868,) and the condition of the lime-soap found therein.)

A. In answer to the first part of the question, I would state that there is no discrepancy between answers to X Q. 518 and 520; for, in X Q. 518, I am required to try the experiment with the addition of fat, and in my answer thereto I state what course I would take in answer to such requisition; whereas, in answer to X Q. 520, I state what
564 course I would take from my own judgment, based upon all previous knowledge. In answer to the last part of the question, I would say that I would sift all the alleged facts of Pelouze in the light of my previous knowledge, and if I could explain the alleged decomposition without having recourse to the assumption of acid or basic lime-soap, I would consider no experiment necessary, and would not perform any.

X Q. 522. Then you have, in fact, performed no experiment to ascertain whether or not a neutral lime-soap will be decomposed into an acid and basic soap when heated with water and neutral fat; is that so?

A. I have stated in detail the results of such experiments, made in 1860, in my testimony in the former suit of Tilghman vs. Werk, in answer 3, page 79, complainant's printed testimony, and also in answer to Question 60, in the present suit, page 116, complainant's printed testimony.

X Q. 523. In the experiment described in Answer 3, page 79, you heated lard and free lime, did you not, for the purpose of decomposing the lard, and not for the purpose of ascertaining whether a lime-soap would be decomposed?

A. It was not made for the purpose of decomposing lard simply, but of ascertaining the resulting products of heating fat, lime, and water at a high temperature, and the resulting products being found to be fat

acids, neutral lime-soap, and glycerine. I would not look for a decomposition of neutral lime-soap, nor was the experiment instituted with the view of ascertaining such decomposition of lime-soap.

X Q. 524. What is understood by the terms neutral lime-soap, acid lime-soap, and basic lime-soap, respectively, assuming the existence of the last two?

A. Neutral lime-soap consists of an atom of fat acid and an atom of lime. For example, in stearic lime-soap, twenty-eight pounds of lime are combined with 275 pounds of anhydrous stearic acid. Acid lime-soap would consist (assuming its existence) of more than one atom of stearic acid to one atom of lime, and basic lime-soap would consist of an atom of stearic acid to more than one atom of lime.

X Q. 525. Assuming that during the progress of a decomposition, as in Pelouze's experiment, the neutal lime-soap was decomposed into an acid and a basic soap, would you expect to find the soap acid,
565 basic, or neutral, at the end of the operation—there being an excess of fat and all of the fat being decomposed?

A. On the assumption in the question I would expect to find the products of the decomposition to be acid lime-soap and basic lime-soap.

X Q. 526. On the same assumption you would expect to find, at the end of the operation, a quantity of free alkali and free acid existing together without saturating each other?

A. I would expect to find, (on the assumption in question,) acid lime-soap and basic lime-soap.

X Q. 527. On the same assumption you would expect to find, after the withdrawal of the decomposing agent, (heat,) a quantity of alkali, unsaturated by an acid, and a quantity of acid, unsaturated by alkali, existing together?

A. On the assumption in the question I would expect to find acid lime-soap, consisting of acid not saturated with lime, and a basic lime-soap, consisting of lime not saturated with acid.

X Q. 528. Aside from all theory, what do you understand to be the cardinal fact which is the subject-matter of the paper of Pelouze?

A. I consider the cardinal fact to be the heating of a mixture of fatty matter—four per cent. lime and water, or a mixture of fatty matter, lime-soap and water, or a mixture of fatty matter, Marseilles soap, and water—in a close vessel, at a high temperature and pressure, (about 311° to 330° F.,) and the resulting products of the decompositions were an aqueous solution of glycerine and a fatty acid precipitate, which, when treated by boiling dilute muriatic acid, yielded free fat acid.

X Q. 529. You understand, do you not, that in one of the experiments conducted by Pelouze, he prepared a soap of lime by double decomposition, which, together with water and olive-oil, he heated during nearly three hours to a temperature of 311° to 330° F., and produced, as he claims, a decomposition of the fat?

A. I so understand it.

X Q. 530. You understand, further, do you not, that he claims—as the result of the double experiment which he describes—that "the soaps are as fit as the alkalies themselves to determine the undoubling of the fatty bodies into glycerine and into fatty acids?"

566 A. I understand such to be his claim.

X Q. 531. Do you think that the truth of the fact asserted by him, as stated in X Q. 530, depends upon the correctness of his theory as to the decomposition of the lime-soap?

(Question objected to by complainant's counsel on the ground that what is stated in X Q. 530 is not a fact, but is the theory of Pelouze.)

A. Since his theory of the decomposition of neutral lime-soap into acid and basic soap is, according to my research and experience, entirely without foundation, his explanation, as expressed in X Q. 530, of the cardinal facts, stated in my answer to X Q. 528, is likewise erroneous.

X Q. 532. Do you deny the fact that the soap of lime has any power to decompose fats when heated therewith in the manner described by Pelouze?

(Question objected to on the ground that it assumes as a fact what is only a matter of theory.

Counsel for defendants protests against the counsel for complainant reading aloud to the witness his objection to the question.)

A. I know of no fact warranting such an assumption as to the decomposition of fat by neutral lime-soap.

X Q. 533. Did you ever conduct an experiment to decompose fats by neutral lime-soap in the manner described by Pelouze?

A. I have not mingled neutral lime-soap, fat, and water, and subjected them to a high temperature and pressure, with a view of determining the correctness of the theory asserted by Pelouze. I have performed the experiment indirectly, as in the first two experiments detailed in answer to question 37, page 110, complainant's printed testimony.

X Q. 534. In the experiments referred to by you you employed free caustic lime, did you not?

A. I did.

X Q. 535. In one you heated water, with half its weight of lard and one-half per cent. of caustic lime, to 320° F., for twelve hours. In the other you heated 100 parts of lard, with 130 parts water and six and a half parts of lime, to 350° F., during six hours, did you not?

A. I did.

567 X Q. 536. Do you mean to say that either of these experiments was the same as either of those described by Pelouze as to time and material employed?

A. Neither of them was precisely the same in those points, but in principle, and virtually, they were the same. In all of them neutral fat, water, high temperature, and pressure are the same, although not according to the exact degree of temperature; but in Pelouze's, lime-soap is used, whereas in mine free lime was employed; but these were in this respect the same in principle, since in all of them the quantity of lime is insufficient to make neutral lime-soap of all the fat, and since free lime, under the conditions of the experiment enunciated, will rapidly form neutral lime-soap by the decomposition of a portion of the fat.

X Q. 537. Then it follows, does it, that the heating of fat lime-soap and water is the same in principle as the heating of fat, free caustic lime, and water. Is that so?

A. It is virtually so, under the conditions of equal proportions of lime, fat, water, temperature, and pressure.

X Q. 538. And, per contra, it is not virtually so, under the conditions of unequal proportions of lime, fat, water, temperature, and pressure; is that so?

A. The principle would not be altered, but the proportionate amount of decomposition or change might vary.

X Q. 539. What do you mean by the word "principle?"

A. The principle alluded to is, that where there is an insufficient quantity of lime used to saturate all the acid derivable from a given quantity of fat, or where there is a quantity of lime-soap and neutral fat,

there would be no difference in the resulting products under the other condition of water at a high temperature and pressure, except in proportion of products due to the varying proportions of free lime, or the lime contained in the lime-soap used.

X Q. 540. And in all the conditions named by you, did not each of your experiments differ from each of those of Pelouze?

A. Each of mine differed from each of Pelouze's in not employing precisely the same conditions of proportion of material and time, being the same, or nearly the same, in temperature: and mine also differed from his in employing free lime instead of lime soap or Marseilles soap.

568 X Q. 541. Then you never made, nor have seen made, an experiment under the precise conditions of those made by Pelouze; is that so?

A. Not under the precise numerical conditions.

X Q. 542. Suppose that you had made, or had seen made, an experiment in which fat and water alone were heated together to a given temperature—say 320° to 330° F., for a given time, say three hours, and another experiment, in which fat, water, and neutral lime-soap were heated together for the same time and to the same temperature, all the other conditions being the same in the two experiments, and in the first but a trace of decomposition of the fat was produced, and in the last all the fat, or nearly all of it, was decomposed—would you infer that the lime-soap had no influence in effecting the decomposition?

A. Assuming the facts stated in the question, I would infer that the lime-soap aided the decomposition, (but would have no ground whatever to infer that its assistance was due to the decomposition of the lime-soap into an acid and a basic soap, or to infer that the lime-soap had any chemical influence whatever in effecting the alleged decomposition.)

(So much of the foregoing answer as is included in parentheses objected to, because the witness was not asked his opinion as to the character of the influence of the lime-soap, whether chemical or mechanical, but as to the fact.)

X Q. 543. X Q. 542 repeated.

A. Answer to X Q. 542 repeated to the parentheses.

X Q. 544. And would you infer that the processes, conducted as per said experiments, were the same, or different, practically or theoretically considered, and in the results obtained by each?

A. I would consider them technically different.

X Q. 545. Upon the supposition that the usual charge of fat employed by the defendants, say 6,000 pounds, together with 480 gallons of water, (the usual quantity,) was placed in their digester, and heated by superheated steam in the usual manner to a temperature corresponding to a pressure of about seventy pounds—a temperature under 320° F. —for the usual time, say eight hours, (the conditions being as described in the testimony of Dr. Smith, page 86, defendants' testimony,) and a decomposition of the fat, amounting to a little over ten per

569 cent., resulted therefrom, what time would you infer would be required for the decomposition of the other nine-tenths of the fat, at the same temperature and pressure in said apparatus?

A. Never having seen said apparatus, I can only give an opinion on the facts as stated in the question. My opinion is that when a given amount of decomposition takes place in a given time, under certain conditions, it is impossible to predict how much longer time it would require, under like conditions, to effect a total decomposition.

X Q. 546. Have you an opinion as to whether or not the decomposi-

tion of the other nine-tenths of the fat in the defendants' digester would proceed at a slower or a more rapid rate than the first tenth? If so, state your opinion.

A. My opinion is, on general principles, that the decomposition would be more rapid until one-half or more were decomposed, and would then become less rapid, until finally the last tenth would be decomposed with equal or greater slowness than the first tenth. But I can only assert such a result as a general principle, which might not be applicable to the supposed case; and in such supposed case I could not form a positive opinion without actual trial.

X Q. 547. Give your reasons for the opinion you have thus expressed.

A. In the decomposition of nitric acid by several metals, silver, &c., the rate of progress of decomposition is as I have stated. In the decomposition of water by sulphuric acid and zinc or iron, the evolution of the hydrogen indicates a similar rate, beginning slowly, increasing in rapidity towards the middle, and diminishing towards the close of the operation.

X Q. 548. In the patent of R. A. Tilghman, of May 15th, 1860, it is stated as follows: "I have observed, in working this process, that though the action of the water in extracting the glycerine from the fats is rapid at first, when the water is fresh and the fat contains all its glycerine, yet, as the decomposition advances and the fat gradually loses, and the water takes up the glycerine, that the decomposition becomes slower and slower," &c. * * * If this be true, and the testimony of Professor Smith be true, wherein he states that about one-tenth of the fat was decomposed in eight hours in defendants' digester, when
570 water and fat alone were used, then more than eighty hours would have been required to decompose all the fat in defendants' digester, would it not?

A. In my opinion, no such conclusion as to the proportion of time can be drawn. My opinion is based on my own experiments as well as on general principles.

X Q. 549. Without reference to "your own experiments and to general principles," and assuming the truth of the premises in the preceding question, will you state whether or not, in your opinion, more than eighty hours or less than eighty hours would have been required for complete decomposition in Prof. Smith's experiment?

(Complainant's counsel asks whether the question is to be understood as meaning that the witness is to exclude all his own knowledge and experience.

Counsel for defendants replies by saying that he has the right to assume the truth of certain facts, and to ask the opinion of the witness based solely upon the truth of such facts, which he has done, and now requests the witness either to answer the question, to refuse to answer it, or to say that he cannot answer it.)

A. As I consider it an absurdity in its very nature for a chemical expert to give an opinion upon the possible results of alleged chemical facts, without reference to his research and experience in relation to those facts, and without reference to general principles, I find it impossible to give a further answer to the question than is given in the answer to X Q. 548.

X Q. 550. Is the statement quoted from the complainant's patent of 1860 true or untrue, in your opinion?

A. I have not tried the experiment, but on general pinciples I believe it to be true, except that at the first moment the action is slow, and then

increases in rapidity, until the quantity of glycerine dissolved in the water diminishes its rapidity.

X Q. 551. Assuming that in defendants' digester one-tenth of the fat is decomposed by water alone at a given temperature in eight hours, and assuming the truth of the passage quoted from the complainant's patent of 1869, will you now state how long would be required for the decomposition of the other nine-tenths at the same temperature?

571 A. As already stated, it is impossible for me to draw a conclusion as to precise time; but from my own experiment, detailed in answer to X Q. 36 of my first examination, page 110, complainant's printed testimony, it would not require more than twenty-four hours.

X Q. 552. In your said experiment you used lard with twice its weight of water, treating it for eleven hours at 320° F.; you then drew off the water, and added twice the weight of the lard of fresh water, and continued the operation at the same temperature for thirteen hours more, did you not?

A. I did; but to show the impracticability of drawing conclusions as to exact time, I state that whereas in defendants' testimony from seven to thirteen per cent., or an average of ten per cent. of decomposition was obtained in eight hours, I obtained a decomposition of eighty per cent. at the same temperature in eleven hours, with the same water. It would appear, further, that, under the same circumstances, defendants' experts observed no appreciable decomposition in three hours. Since, then, three hours produced no appreciable decomposition, and five additional hours decomposed on an average ten per cent., and three more additional hours decomposed eighty per cent., I find in these facts no basis whatever for numerical deductions as to the amount of decomposition by time, since the general conditions of temperature and materials were the same in all these experiments.

X Q. 553. As you used lard in your experiment, and Smith and Wayne used tallow in theirs, then, in this respect, the conditions were not the same; is that so?

A. They were not identical as to tallow and lard, but certainly as near as practice could demand, since the manufacturers employ either tallow or lard, according to the state of the market.

X Q. 554. Do you not know that lard is much more easily decomposed than tallow, or do you know that it is not so?

A. As far as I know, it depends upon the commercial condition of either, whether more or less rancid, or pure; but with equal purity I have no positive knowledge on the subject.

X Q. 555. As you used in your first eleven hours twice as much water as lard, and then substituted another equal charge of water, and as Smith and Wayne used but one charge of water of 480 gallons—

572 3,840 pounds to 6,000 pounds of fat—then, in these respects, your experiment differed in conditions from that of Smith and Wayne, did it not?

A. My experiment, in which the whole of the fat was decomposed in twenty-four hours at most, differed from the quoted experiment of Smith and Wayne in the proportion of water and in my changing the water; but in the first eleven hours of my experiment, when four-fifths of the fat was decomposed, it differed from theirs in the proportion of water, the water not being changed.

X Q. 556. How much lard did you use in your said experiment?

A. It was a number of ounces—less than a pound.

X Q. 557. Your testimony, as given heretofore in this cause, assumes

that the power of the lime in defendants' process ceases when it has formed neutral lime-soap, does it not?

A. My opinion is that the chemical decomposing power of the lime ceases with the formation of lime-soap.

X Q. 558. It further assumes or asserts, does it not, that in defendants' process, in which four per cent. of lime is used, six-tenths of the fat is decomposed by the sole power of highly-heated water?

A. My opinion is and has been that after the four per cent. of lime shall have decomposed four-tenths of the fat and formed lime-soap, the remaining six-tenths of the fats are solely decomposed by the highly-heated water.

X Q. 559. Then you mean that the lime or the lime-soap in defendants' process does not at all aid the water in the decomposition of said six-tenths of the fat: is that so?

A. I have never expressed it so, nor do I mean it so: but I mean that the highly-heated water, after the formation of the lime-soap, is the sole chemical agent affecting the decomposition, although I am aware that agitation will hasten such chemical action: and, moreover, since defendants' experts and exhibits show that lime-soap is first formed, and then dissolved in the remaining fat, and forms an emulsive mass with the water, thereby increasing the surface of contact of the water and fat, my opinion is that, by reason of such increased surface, the chemical decomposing action of the highly-heated water is made more rapid in time.

X Q. 560. In your former examination, answer to question
573 39 in-chief, you say, "The free fat acids thus produced are exclusively produced by the action of highly-heated water, as set forth in complainant's patent." Do you now adhere to said answer, in its exact terms? Will you answer yea or nay?

A. Yea. (My quoted answer refers to the chemical action of highly-heated water, which I still esteem as the sole agent in producing the free fat acids, without reference to the adventitious aids of extension of surface by agitation, or the emulsive influence of lime-soap. This might be inferred from experiments detailed in answer to question 36 of my former examination, where, in the first experiment, the action of highly-heated water alone was shown to resolve fat into fat acids and glycerine, without either of the two adventitious aids above mentioned.)

(The part of above answer in parentheses objected to as irresponsive to the question, and question repeated.)

X Q. 561. X Q. 560 repeated.

A. (The whole answer repeated, with the addition.) I therefore adhere to the answer referred to in its exact terms.

X Q. 562. Do you now testify that the lime-soap in defendant's process aids, or does not aid, in any manner, the water in the decomposition of said six-tenths of the fat?

A. It is my opinion that the lime-soap aids the highly-heated water in the manner explained in my answer to X Q. 559.

X Q. 563. You think, then, that said six-tenths, of the fat is decomposed by the combined action of the lime-soap acting mechanically, and the water acting chemically: is that your opinion?

A. In speaking of a chemical action, and the mechanical means by which the said chemical action may be promoted, it would seem to me erroneous to call it a combined action. In the case supposed, it being my opinion that lime-soap, without the presence of highly-heated water, would not effect any decomposition of a neutral fat, and since highly-heated water will effect such decomposition without the presence of lime-soap, then, when lime-soap and highly-heated water are both present, I

would say that the whole chemical action is due to highly-heated water—the lime-soap acting mechanically to facilitate such action.

574 X Q. 564. Then, you mean that said six-tenths of fat in defendants' digester is decomposed by the action of the highly-heated water acting chemically, and the lime-soap acting mechanically, both acting simultaneously.

A. That is my meaning.

X Q. 565. Assuming that eighty hours would be required for decomposition of the fat in defendants' digester, with the use of water alone and without lime, and that, when lime is used to the extent of four per cent., entire decomposition is effected in the space of eight or ten hours, the other conditions being the same, to what other influence, if any, do you attribute the decrease in time in the latter case, than to the action of the lime and lime-soap?

A. Assuming the data in the question—although I think the assumption of eighty hours wholly unwarranted by the facts—I would attribute the decrease of time to the chemical action of lime to make lime-soap, and to the mechanical aid given by the lime-soap thus formed to the chemical action of the highly-heated water.

X Q. 566. Would you consider a process in which fat was decomposed into free fat acids and glycerine, by the sole agency of water at a temture of, say, 320° F., the time required being eighty hours, on the one hand, and on the other, a process in which fat was decomposed into a mixture of neutral lime-soap and free fat acids and glycerine by the agency of water, lime, and lime-soap, acting simultaneously, at the same temperature, the time required being eight to ten hours, to be one and the same process, in a practical or technical sense?

(Complainant's counsel inquires whether, by the terms "practical and technical," used in the question, it is to be understood that the same efficient agents are practically used to produce the same results in both cases.

Defendants' counsel replies that the words are used in the same sense as employed in X Q. 544, to which question the witness gave a direct answer, and the witness not having intimated that he does not understand the meaning of said words in the question last addressed to him, it is assumed that he does understand their meaning, and that no explanation thereof is necessary.

Complainant's counsel objects, that the terms "practical and
575 technical sense," as used in the question, are vague and indefinite, and involving questions of law, as to which a chemical expert cannot be expected to answer.)

A. Interposing the same objection to the time of eighty hours, as beyond my experience, I will say that, as far as the action of lime and consequent formation of lime-soap is concerned, the two processes are different. As far as the action is concerned in producing free fat acids, the processes are identical, in a practical, technical, and theoretical sense, because highly-heated water is the sole chemical agent in both. It is a question for the manufacturer to determine—whether fat acid could be produced by the process in the assumed length of eighty hours, by highly-heated water alone, at an equal profit, as in the other process in which lime, and subsequently sulphuric acid, is employed, and in which the decomposition of the fat is effected in eight or ten hours.

X Q. 567. And you consider the resulting products of the two processes—to wit, one free fat acids and glycerine; the other, a mixture of neutral lime-soap and free fat acids and glycerine—to be the same products, practically or technically considered, do you?

A. As stated in my answer to the previous question, I consider them different as far as the lime-soap portion of the product is concerned, and the same as far as the free-fat-acid portion of the product is concerned.

X Q. 568. Could the mixed lime-soap and free-fat-acid product of defendant's process be employed practically in the state in which it is taken from the digester? If not, why not?

A. It could not for the immediate manufacture of stearic-acid candles, without the decomposition of the lime-soap formed by the use of an acid, so that all the fat acids can be obtained together; because stearic candles, containing such a large portion of lime-soap, would not burn well.

X Q. 569. Having testified that, in your opinion, six-tenths of said defendants' product is free fat acids, why could not said six-tenths be immediately employed in the manufacture of candles, and what is necessary preliminarily to its being so employed?

576 A. This is a question rather for the manufacturer than for the chemical expert; but I have no doubt that the reason is, that the six-tenths of free fat acids are intimately blended with the four-tenths of lime-soap, and, before such employment in the manufacture of candles, it should be boiled with dilute sulphuric acid to decompose the said four-tenths of lime-soap, and eliminate the fat acid therein contained.

X Q. 570. Could the six-tenths free fatty acids be separated (so as to be manufactured into stearic-acid candles) from the four tenths lime-soap by any mechanical means? If so, what?

A. I have effected such separation by mechanical means; but whether it would be profitable so to do, is a question for the manufacturer.

X Q. 571. What percentage of the product did you thus separate mechanically, and was it stearic acid or oleic acid?

A. As stated in answer to question 53 of my first examination, I separated by squeezing a sample of defendants' product into neutral lime-soap and free fat acids. I did not determine the proportions of stearic and oleic acid. The fluid nature of the product would show that it was principally oleic acid.

X Q. 572. What is the pressure of steam due to a temperature of 440° F.?

A. 360 pounds to the square inch.

Re-examined by counsel for complainant:

Q. 573. Do your own experiments and your analyses of the products of the defendants prove that when fat, with from one-half per cent. to six and one-half per cent. of lime, and water, are heated together to a high temperature and pressure, all the lime-soap which is produced is in the state of neutral lime-soap, and none of it in the state of acid lime-soap or basic lime-soap?

A. They all prove that all the lime-soap is neutral lime-soap, and none of it acid lime-soap or basic lime-soap.

Q. 574. Do your said experiments and analyses prove whether, in the presence of neutral fat or of free fat acids, neutral lime-soap is decomposed into an acid lime-soap and a basic lime-soap, when heated with water to a high temperature and pressure?

A. They prove that it is not so decomposed.

Q. 575. Referring to the increased rapidity of saponification
577 of oil by potash, caused by the addition of alcohol, mentioned in Storer's Dictionary of Solubilities, page 414, and to the explanation thereof given by defendants' expert, Dr. Rand, (defendants' testi-

mony, page 232,) viz, that the contact between the oil and the saponifying agent (potash) is facilitated by the alcohol, (acting mechanically and not chemically,) please state whether or not the decomposition of fat by highly-heated water should, in the same manner, be made more rapid by the presence of any substance tending to facilitate the contact between the fat and the water.

A. It should be so facilitated.

Q. 576. Does the theory of Pelouze (defendants' exhibit, Comptes Rendues) account for the existence of any free fat acids in the products of the defendants—that is, does it explain how any free fat acids are produced from the imaginary acid lime-soap?

A. It does not account for the existence of any free fat acids, but, on the contrary, supposes a chemical combination of the fat acids with the lime.

Q. 577. What is the meaning of the phrase "traces," or "only traces," as used by chemists to describe the quantity of any substance found by chemical analysis? What percentage, as a maximum, would be indicated?

A. Since we can weigh exceedingly minute quantities to less than the one-hundredth of a grain, I would say that the expression "traces" or "only traces," would apply to not more than one-tenth of a per cent., or from one-tenth to one-thousandth of one per cent., or even less.

Q. 578. Please examine the paper now produced, marked "Complainant's Exhibit Booth, re-examination No. 1," and state whether you have verified the correctness of the abstract of experiments therein contained by reference to the testimony and exhibits in this cause.

A. I have verified the correctness of said abstract by reference to the testimony and exhibits.

Recross-examination by C. B. Collier, esq., for defendants:

X X Q. 579. Who was M. J. Pelouze, and what rank, if any, does he occupy among chemists?

578 A. He was a chemist of fair standing in France.

X X Q. 580. What chemical works, if any, has he written and published?

A. A general treatise on chemistry, by Pelouze and Fremy, besides many small essays on chemical subjects.

X X Q. 581. Is not said treatise regarded as a standard chemical authority?

A. As far as I know, in speaking for others, it is generally regarded as a work of but moderate authority; and, in my own experience of its use, I have rarely found it satisfactory as a work of reference, except in such matters of general chemical knowledge as are embraced in all such treatises.

X X Q. 582. State in what particular you have found it unsatisfactory.

A. Without having the work before me, I cannot point out the particular cases, but I speak from general recollection.

X X Q. 583. Does the decomposing power of water upon fat increase in the same ratio or progression, as to time, as increase of temperature?

A. I cannot say that it does, in direct proportion to the degrees of temperature; but, from my own experiments, the time of decomposition is diminished as temperature is increased.

X X Q. 584. Do you know, from experiment, that water under 320° F., in any length of time, would decompose fat?

A. I do not recollect making any experiment below that temperature.

X X Q. 585. Have you an opinion on the subject? If so, please state it, and the grounds of it.

A. I can only form an opinion from facts, and facts would lead me to conclude that traces of decomposition might occur below 320° F.; but how far below, it is impossible for me to say, from lack of facts.

X X Q. 586. Is it your opinion that fats would be decomposed by the action of water at a temperature, say, of 300° F., in any length of time?

A. Not having any facts to base an opinion on, I would prefer not expressing an opinion which would be a mere conjecture.

579 X X Q. 587. If you yourself had not experimented as to the action of water upon fats at 320° F., would not it be mere matter of "conjecture" with you as to whether or not fats would be decomposed by water in any length of time at that temperature?

(Complainant's counsel inquires whether the question is intended to mean that the witness is to exclude his knowledge as derived from information and research.

Counsel for defendants replies that the witness is called upon to answer without reference to his own experiments, or those of others known to him, at that temperature; but, in the opinion that he may express an answer to the question, can state, if he chooses, upon what "information and research" it is founded.)

A. Without my own experiments, and without information received from others, it would be a "conjecture;" but, from information imparted to me previous to my experiments on this point, derived from complainant, such opinion would not be mere conjecture.

X X Q. 588. When you say "derived from complainant," do you mean derived from complainant's patent?

A. As far as my memory serves me, it was derived from complainant, as a matter of friendly information, before I knew of any legal proceedings in relation to complainant's patent.

X X Q. 589. From the complainant's patent alone, had you made no experiment upon the subject, known of none having been made, and not have been told of the fact, could you have said—and do you testify that you would have known—that water at 320° F., in any length of time, would decompose fats; or, on the contrary, would such opinion have been mere matter of conjecture?

A. Under the limitations of the question, the exact degree of temperature named would have been a matter of conjecture; but the 320° F., would, in my opinion, have been embraced in the term, high temperature and pressure, used in the patent, and so far would not have been a matter of conjecture, but of fair opinion.

X X Q. 590. In the complainant's patent it is stated, "I mix the fatty body to be operated upon with from a third to a half its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting-point of lead, (612° F.,) until the opera-
580 tion is complete." Such temperature exerting a pressure, say, from 1,500 to 2,000 pounds to the square inch, will you please state whether or not, in your opinion, such condition could possibly be realized in either apparatus employed by the defendants, as described in their answers?

A. I do not think those conditions could be realized in either of defendants' apparatus, which I understand to be an ordinary steam-boiler, capable of standing only ordinary high pressures.

X X Q. 591. Do you know of, or have you seen, any apparatus employed for practical manufacturing operations in which such conditions as to temperature and pressure could be realized? If so, describe the same.

A. I refer to Perkins' steam-generator, Defendants' Exhibit No. 19.

X X Q. 592. Do you believe that such conditions could be realized, except either in a tubular apparatus, or in a wrought-iron digester of several inches thickness?

A. I know that it can in a tubular apparatus. How far they could be realized in vessels of larger diameter, my knowledge of the strength of iron will not enable me to form an opinion.

X X Q. 593 What do you understand by the term "solution" as employed by chemists; and is it a mechanical or chemical operation?

A. It is the blending of a solid or liquid substance through another liquid, so that neither of the former can be seen in the latter. It is not a chemical operation, but, as a general opinion, I may state that it lies between a chemical and mechanical operation.

X X Q. 594. Are not some solutions accompanied by chemical changes in one or the other of the substances employed?

A. Some are.

X X Q. 595. Calling your attention to your answer to Question 37, in your former examination, (page 110,) please state the manner in which you treated the "fatty product" with alcohol.

A. It was treated with cold alcohol, and the solution filtered off from the insoluble residue. I do not think this residue was treated with hot alcohol.

X X Q. 596. Are you certain that, in neither of the three ex-
581 periments referred to in said answer, you did not treat the residue remaining from the cold alcoholic solution with hot alcohol?

A. I feel now confident, upon recalling an experiment made nine years ago, that it was not treated with hot alcohol.

X X Q. 597. Will the salts of lime existing in natural waters decompose neutral fat at high temperature and pressure?

A. Although I have not made the experiment, I believe that the carbonate of lime would do so, but not the sulphates or chlorides of lime.

X X Q. 598. At what temperature, and in what time, do you think this carbonate of lime would decompose fat?

A. Without having a single direct fact to base an opinion upon, I suppose, from analogy in general, that it would be considerably above 300° F., possibly not before the melting-point of lead; but a more exact opinion as to temperature I cannot give. By inference, from analogy, I would infer that the time would be in some proportion to temperature. I cannot express length of time with greater precision, where both the temperature of the commencement of such decomposition, and the then influence of a higher heat are matters of opinion, without a single direct fact.

X X Q. 599. At a temperature of from say 400° to 600 F., which do you think would first act upon a neutral fat to decompose it—water, or this carbonate of lime?

A. I can only say that water would act within the temperatures named; but I cannot positively say that carbonate of lime would act. My opinion, as far as it can be formed in the premises, is that the water would act before the carbonate of lime.

X X Q. 600. If the water, as you think, would act before the car-

bonate of lime, and eliminate fat acid, would not the carbonate of lime then combine with the thus eliminated fat acid?

A. I believe that the fat acids thus eliminated would immediately decompose the carbonate of lime, forming neutral lime-soap.

X X Q. 601. Assuming, then, the presence of carbonate of lime in the water used in the Perkins engine, do you not infer that the water decomposed the fat in said engine into fat acids, and that the carbonate of lime was then decomposed by the fat acid, and formed a lime-soap to the extent of its combining power?

582 A. Premising that it is wholly a matter of conjecture as to the point of temperature when carbonate of lime would begin to decompose neutral fat, my opinion is, that some fat acids may have been formed by the water, and the lime-soap have been produced, as stated in the question. If it should be found, by experience, that carbonate of lime would decompose the fat at a lower temperature, then, of course, my opinion would be incorrect.

Re-examination by complainant's counsel.

X Q. 602. Would any free fat acid, formed by the action of water on fat, at 320° F., immediately decompose any carbonate of lime present in the water, and form a lime-soap?

A. My opinion is, that it would immediately so act.

X Q. 603. Have you made any experiment to ascertain whether by heating to 320° F., oil, with neutral lime-soap and without the presence of water, any free fat acid is produced? If so, describe said experiment and its results.

A. I heated sixty parts of olive-oil, with forty parts of neutral lime-soap, for eight hours, at a temperature of 320° F., and, upon examining the result found that no fat acid was produced. I made this experiment yesterday.

X Q. 604. Have you made any experiment to ascertain whether by heating oil, neutral lime-soap, and water to 212° F., any free fat acid is produced? If so, describe your experiment and its results.

A. At the same time I heated sixty parts of olive oil with forty parts of neutral lime-soap and water, for eight hours, at a temperature of 212° F., and, upon examining the product, found no trace of fat acids.

Recross-examination:

X X Q. 605. In your first experiment of yesterday, state how the materials—lime-soap and olive-oil—were placed in the apparatus employed, as to admixture.

A. They are melted together, so that the lime-soap was dissolved in the olive-oil.

X X Q. 606. In what condition, as to admixture, were they at the end of the operation, after cooling?

583 A. They formed a tough, brownish-colored mass, intimately blended together.

X X Q. 607. How did you treat this mass, in order to ascertain its chemical nature?

A. I heated it with alcohol, in which was inserted a slip of blue litmus paper; as this paper turns red with the presence of the merest traces of acid, and as it remained blue during my whole experiment, I infer that no fat acids had been produced?

X X Q. 608. Did the alcohol dissolve this mass?

A. It did not.

X X Q. 609. Did you ever heat the defendants' finished product with alcohol, and then apply litmus paper to see if it would remain blue, or be unacted upon?

A. I did, and found that it gave an acid reaction reddening the litmus paper.

X X Q. 610. What proportion of the mass in your said experiment of yesterday, if any, was dissolved by the alcohol?

A. I did not attempt to determine whether any was dissolved, but merely wished to ascertain whether any free fat acid had been produced.

X X Q. 611. Did you ever melt the defendants' finished product, and apply litmus paper to it; without alcohol, to ascertain whether it was neutral or acid?

A. I have not, because I could not test the presence of free fat acids without the use of a solvent for it.

X X Q. 612. If sixth-tenths of defendants' product, as testified to by you, is free fat acid, and, as litmus paper turns red with the presence of the merest traces of acid, as also testified to by you, then it should be reddened by being inserted into defendants' product when in a melted state, should it not?

A. It should not, because a free acid must be in solution to give the acid test with litmus paper.

X X Q. 613. Have you not already testified that said free acid in defendants' product is in solution with the other portion of the product—the lime-soap portion?

A. I have rather said that the lime-soap was dissolved in the free fat acid.

JA'S C. BOOTH.

DEFENDANTS' EXHIBIT BOOTH, RE EXAMINATION NO. 1.

Abstract of experiments.

	Experimenter.	Page of testimony.	Materials used.	Heat.	Time.	Percentage of fat acids produced.	Remarks.
					Hours.		
1	Dr. Rand	214, defendants' test'y	Fat and water	320° F.	3	Traces only.	In laboratory.
2	Wayne	144, " "	" "	320° F.	3	"	" "
3	"	143, " "	" "	320° F.	8	7.23	Defendants' factory.
4	"	143, " "	" "	320° F.	8	11.35	" "
5	Dr. Smith	87, " "	" "	320° F.	8	10.	Laboratory.
6	"	88, " "	" "	320° F.	8	10 to 13.	"
7	"	86, " "	" "	320° F.	8	Over 10.	Defendants' factory.
8	Booth	108, plaintiff's testimony	" "	320° F.	11	80.	Laboratory.
9	"	109, " "	" "	320° F.	24	All.	"
10	French jury	Defendants' exhibit	" "	356° F.	6	"	Factory.
11	Ropes	8, Tilghman vs. Mitchell	" "	367° F.	12	"	Factory. Prime lard stearine.
12	"	8, " "	" "	367° F.	20	"	Factory. Not prime lard stearine.
13	Verdin	57, defendants' test'y	" "	374° F.	36	Under 75.	Factory. Without agitation.
14	Mitchell	7 & 57 " "	" "	374° F.	8 to 10	All.	Factory. With agitation.
15	Jones	27, Tilghman vs. Mitchell	" "	422° F.	5	"	Factory.
16	Booth	110, plaintiff's testimony	" "	612° F.	1-12	"	Laboratory.
17	Wayne	149, defendants' test'y	109 fat, 127 lime-soap, water	320° F.	3½	57 to 60.	"
18	Rand	214, " "	100 fat, 40 lime-soap, water	320° F.	3	Nearly all	"
19	Smith	88, " "	Fat, 4 per cent. lime, water	320° F.	8	All.	"
20	Wayne	144, " "	" " " "	320° F.	8	"	"
21	Booth	110, plaintiff's testimony	Fat, ½ per cent. lime, water	320° F.	12	"	"
22	"	110, " "	Fat, 6½ per cent. lime, water	350° F.	8	"	"
23	Ropes	12, Tilghman vs. Mitchell	Fat, ½ per cent. lime, water	367° F.	6 to 7	"	Factory.
24	Jones	27, " "	" " " "	405° F.	4 to 5	"	"

JAMES C. BOOTH.

585 SEPTEMBER 13TH.

Present, B. C. Tilghman, esq., counsel for complainant, and C. B. Collier, esq., counsel for defendants.

J. EUGENE MATHEWSON, a witness produced and examined on the part of the complainant, being duly sworn, says:

Question 1. What is your name, age, residence, and occupation?

Answer. J. Eugene Mathewson; twenty-eight years of age; mechanical engineer; reside at Manayunk, Philadelphia.

Q. 2. Are you practically acquainted with the working of steam-engines? If so, state where and how long you have been in practical charge of a steam-engine.

A. I am practically acquainted with the working of steam-engines. For two years at Neosho, Wisconsin, I had practical charge of a steam-engine, and for three years I had charge of the steam-engine at the printing-office of the Philadelphia Inquirer, Philadelphia.

Q. 3. Of what horse-power was said engine in Philadelphia; and what steam-pressure was used in it?

A. Twenty-five horse-power. It used steam of sixty-five pounds pressure.

Q. 4. How much oil or tallow, on an average, did you use to lubricate the piston of said engine in a day of ten hours?

A. About three-quarters of a pound.

J. EUGENE MATHEWSON.

Agreements.

It is agreed and admitted by the counsel for the respective parties, as a matter of general, practical, and scientific information, that steam-engines ordinarily evaporate one cubic foot of water, weighing sixty-two pounds, per hour for each horse-power.

B. C. TILGHMAN,
Counsel for Complainant.
CHA'S B. COLLIER,
Counsel for Defendants.

PHILADELPHIA, *September 13th*, 1869.

586 It is hereby agreed that the copy of the letter hereto annexed, dated London, June 23d, 1856, signed R. A. Tilghman, is a true and correct copy of a genuine communication of that date.

And the same is agreed as to the copy hereto annexed of the letter of J. P. Wilson, dated London, July 13th, 1865.

But nothing is admitted as to the admissibility of such documents as evidence, other than that the copies may be used for all purposes for which the originals may be competent.

CHA'S B. COLLIER,
Counsel for Defendants.

PHILADELPHIA, *September 13th*, 1869.

Counsel for complainant offers in evidence copies of the letters of R. A. Tilghman and J. P. Wilson, referred to in above agreement.

Objected to by counsel for defendants.

(Copy.)

COMPLAINANT'S EXHIBIT EMERY.

14 SOUTHAMPTON PLACE, EUSTON SQUARE.
London, June 25th, 1856.

THO'S EMERY & SON, *Cincinnati.*

GENTLEMEN: I have received from Mr. Davenport your favor of 30th of May last. Our experiments in the factories here and in Paris have shown that, on the large scale, the decomposition of fats by water is more conveniently effected by modifying the apparatus originally proposed, so that the fat and water are exposed to a comparatively lower heat and pressure for a longer time, instead of a very high pressure for a few minutes; and a considerable quantity of material is treated at one charge, in an ordinary steam-boiler, lined with lead or copper and provided with an agitator, in place of using the continuously-working pumps and coil of pipes. At a pressure of 225 pounds per inch, tallow, or palm-oil, or lard stearine, is completely decomposed in five
587 hours. In the course of a few months we shall probably have going on at Price & Co.'s works an apparatus on the above plan capable of treating several tons per day. Until my process is in actual use in England I have decided not to begin its introduction into the United States, and therefore cannot at present reply to your request as to terms of sale. As soon as it is well established here, I intend returning home, and will immediately communicate with you. I give below answers to such of your questions as I have materials for, and remain,

Very respectfully yours,

R. A. TILGHMAN.

Answers to questions.

1. The process is not practically at work on the large scale, but Price & Co., of London, and the Companie Gen rale de Stearinerie, Monier & Co., La Villette, Paris, are engaged in experiments preparatory to starting it.

2. The process is applicable to all sorts of fats and oils, vegetable or animal, hard or soft.

3. There is no other waste than the dirt and glycerine.

4. From 100 pounds clean dry tallow we obtain 97½ pounds fat acids and eight pounds concentrated glycerine.

5. The color of the product depends upon that of the original material. Palm-oil product is of a light gray color. Tallow and stearine are somewhat whiter than the same material would produce by lime saponification.

6. In this respect the product resembles that from lime saponification of the same materials.

7. Yes: hot and cold pressing—just like saponified stuff.

8. Hydraulic presses are used. The product is more crystalline, and presses better than saponified stuff.

9. The danger is no greater than in working ordinary steam-boilers.

10. Answered in No. 9.

11. The apparatus is of ordinary boiler and coppersmith work, and the cost can be calculated by any one in those trades.

588 12. There is no more wear than in the ordinary lead or copper lined tubs.

13. A boiler forty feet long by thirty-two inches diameter, at 225 pounds per inch, would decompose 4,500 pounds in six hours.

14. Tallow and good stearine give, by pressing, a perfectly white product. Palm-oil or dark fat would require to be distilled after going through the apparatus.

15. For good white material, like tallow, or good lard stearine, the lime-saponification process is the best. For cheap dark stuff, like palm-oil, grease, lard, stearine, &c., the sulphuric distillation is preferable. In France they generally use both processes in the same factory. Saponification for white, distillation for dark material. To distill white fats would not be economical, as the waste by tar, &c., would more than balance the saving by acid.

16.

17. The same product as from perfectly decomposed saponified stuff.

18. There is no offensive smell.

19.

COMPLAINANT'S EXHIBIT WILSON.

PRICE'S PATENT CANDLE COMPANY, LIMITED.
Belmont Works, Battersea, London, S. W., July 13th, 1865.

R. A. TILGHMAN, Esq.,
1123 *Spruce Street, Philadelphia.*

DEAR SIR: I thank you for your letter of 19th of June, which I have laid before the directors to-day; and they will be much obliged if you will, as you kindly offer, procure for us tracings of the working-drawings of the apparatus now in use for your process in America, and most approved of by you, at any such cost as you mention—of about twenty dollars. You will tell us, in sending them, how to pay the money.

You are right in supposing that the apparatus we have now at Battersea is just what you saw or heard about when you were here. There is a stirrer in each vessel, but plainly insufficient for the proper
589 contact of the water with the fatty body. I should think we may very probably use our present digesters for the outer iron vessels of your apparatus, putting them, of course, up on their ends. They are very much the shape of the vessels you describe. You do not mention what quantity of water you put to the fat. I should think it might be well to put it in at two doses. Drawing off the first where it has taken up the bulk of the glycerine, and then finishing off with fresh water to take the last part of it away; using this water again as the first water for a fresh change of fat. But very likely you already do this. The whole of your letter now being replied to, as well as of the previous one, was of much interest to us. If any further matters occur to you as worth mentioning in connection with the working of the process on your side, we shall be much obliged by your stating them when you write again.

I am, dear sir, yours faithfully,

J. P. WILSON.

Counsel for complainant offers in evidence certified copy of the docket entries in the suit of Richard A. Tilghman vs. Michael Werk, No. 1270, circuit court of United States, southern district of Ohio.

Objected to by counsel for defendants, for the reason that the same is not binding as against the parties to this suit—for the further reason that no final judgment was entered in said cause No. 1270, and also, for the reason that the whole record of the cause must be offered, if it is competent for any purpose.

Docket entries No. 1270.

Circuit court of the United States, seventh circuit and southern district of Ohio.

RICHARD TILGHMAN
vs.
MICHAEL WERK. } 1270. In chancery.

November 11th, 1859. Bill filed and subpœna issued to first Monday of December, 1859.

590 January 6th, 1860. Leave to defendants to answer, and answer filed; continued to April term.

January 17th. Replication filed; continued to April term.

March 30th. Deposition of Charles Grant on behalf of defendants filed.

April 28th. Deposition for defendants filed.

October 9th. Depositions on behalf of plaintiff filed.

October 10th. Deposition for plaintiff filed.

October 18th. Leave to file, &c.; replication filed.

October 18th. Exhibits produced before Cha's F. Heazlitt filed.

November 1st. Deposition for defendants filed.

October term. (L. 58,) leave to amend answer and amendment filed; (L. 60,) argued and taken under advisement.

February 19th, 1861. Deposition on behalf of plaintiff filed.

1862. April term, (L. 289,) decree referred to Cha's M. Collins, to state account, &c.; (L. 330,) continued to October term; (L. 388,) continued; O. L. 453, continued; October term, continued.

1864. February term continued.

October 14th. October 14th, and continued.

March, 1865. March 2d, affidavit to motion filed.

May 2d, 1865. Rule against defendants for contempt, (M. 379.)

July 27th, 1866. E. S. Wayne; receipt in full for all demand in this case for M. Werk.

January 9th, 1868. Case settled, costs paid, and suit dismissed, (N. 388.)

I, John McLean, do hereby certify that the foregoing is a true and correct transcript of the docket-entries in the above-entitled cause, taken from the docket of said court, now in my office.

In testimony whereof I have hereunto set my hand and affixed the seal of said court, at Cincinnati, this 3d day of July, 1869.

JOHN McLEAN, *Clerk.*

591 *Offer to show process.*

Circuit court U. States, southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz.

Circuit court U. States, southern district of Ohio.

RICHARD A. TILGHMAN
vs.
GEORGE SHILLETO.

1114 GIRARD ST., PHIL'A, *May* 24, 1869.

CHARLES B. COLLIER, Esq.

DEAR SIR: Will you please inform the above-named defendants that I will be glad to show the operation of my patented process in both the forms of apparatus described in my patent of October 3d, 1854, at my laboratory in Philadelphia?

Please let me know as soon as possible whether they wish to avail themselves of this offer.

I will then have my apparatus put together, and we will arrange for any day that will suit the convenience of both parties before the time fixed for closing the testimony.

Yours truly,

R. A. TILGHMAN.

Service accepted May 24th, 1869.

CHA'S B. COLLIER,
Counsel for the Defendants.

592 *Application and correspondence of R. A. Tilghman.*

The second part of my invention consists in a process for producing soap by acting on the fatty or oily body by a solution of carbonated alkali.

For this purpose I mix the fatty bodies, in a liquid state, with the quantity of carbonated alkali, in solution, which may be necessary to convert it into soap, and then subject the mixture to a high temperature and pressure in like manner as hereinbefore described in practicing my mode of obtaining fatty acids and glycerine.

And for this purpose the apparatus hereinbefore described for producing the fatty acids and glycerine by a continuous process may be used for the production of soap in a similar manner.

The carbonated alkali may be dissolved merely in the quantity of water intended to remain in the soap produced.

If resinous or other matters are intended to be used in the manufacture of the soap, they may be dissolved, either in the alkaline solution or the oil, or may be combined with the soap after it has left the apparatus.

The degree of heat required is less than that which is necessary to produce free fat acids, and should generally be kept between the melting points of tin and bismuth, (440° F. to 510° F.

At about 350° F. the neutral fats will form soaps with the alkaline carbonates, but a higher temperature will produce the result more quickly.

The carbonic acid expelled from the alkali in this process, when performed in the apparatus above described, escapes as the soap issues from the exit valve. If but little water has been used and the quality of the soap is sufficiently good without further purification, it can be put into frames to harden at once, or it may be put into the coppers, boiled up, and separated from the glycerine, and finished in the usual manner.

Having now described the nature of my said invention, and the manner of performing the same, I hereby declare that I claim as my invention—

First. The manufacturing of fat acids and glycerine from fatty bodies, by the action of water at a high temperature and pressure; and

Secondly. The manufacturing of soap from fatty bodies, by the ac-

tion of a solution of carbonated alkali at a high temperature and pressure.

(Signed) R. A. TILGHMAN.

593 *Exposition Universelle de* 1855.—*Jury report.*—*Page* 486. "*Stearic candles.*"

(A portion omitted in defendant's printed extract—defendants' testimony, page 261.)

* * The stearic manufacture was originated in France. It is founded upon the investigations of M. Chevreul as to the constitution of the fatty bodies. In a series of eight memoires, which will remain an imperishable monument of his sagacity, this illustrious chemist has made known the true nature of the neutral fatty bodies, the properties of the acids which we can derive from them, and the conditions under which these acids are formed. All the chemical investigations undertaken since have only served to confirm the scrupulous accuracy of all these observations. We can affirm without fear of contradiction that, with the exception of the undertaking of the saponification of the fatty bodies by water, which remained unknown to him, he has indicated in a clear and precise manner all the scientific bases upon which depend the different methods of practical manufacture of the fat acids employed for making candles.

In fact, M. Chevreul was the first to ascertain the nature of the operation long known under the name of saponification: He demonstrated that, under the influence of soluble or insoluble bases, the neutral fatty bodies split into fat acids and glycerine; he taught us how to isolate the fat acids, by pointing out with remarkable precision all their characteristics, and especially their volatility under given conditions; he also proved that concentrated sulphuric acid splits (decomposes) the fatty bodies, as the bases do. * * * *

593a *Reports of Juries.—International Exhibition*, 1862. *London*, 1863. *Class IV. Sect. A.—Oils, fats, wax, and their products.*

JURY.

P. J. Van Kerchoff, Ph. D., Netherlands, professor of chemistry in the University of Groningen.

W. A. Miller, F. R. S., president of section, London, professor of chemistry, King's College, London.

Anselme Payen, deputy chairman, France, member of the Institute, professor of the Conservatory of Arts and Manufactures, and professor to the Central School of Arts and Manufactures.

J. S. Stas, Belgium, professor of chemistry at the Military School of Brussels, member of the department of science of the Royal Academy of Belgium.

Dr. Stein, professor, Dresden.

George Wilson, F. R. S., joint secretary, London, manager of Price's patent candle-works.

ASSOCIATE.

L. A. de Milly, France, chemical manufacturer.

* * * * *

Page 3.—Considerations of this nature led M. de Milly, as early as 1855, to endeavor to modify the process of saponification by means of lime. Instead of effecting this decomposition at a temperature of 212°,

and employing 14 per cent. of lime, he raised the temperature by working under pressure, and employing only 4 per cent. of lime.

At the present time M. de Milly has, indeed, reduced the proportion of lime to 2½ per cent. This process has been imitated in Austria. Undoubtedly it constitutes a real improvement upon the ordinary method of saponification by lime; but in spite of this considerable improvement, which is in fact but a combination of Mr. Tilghman's mode of saponification by water at a high temperature,* combined with the lime process, we cannot believe that these two methods of saponification, under any modification at present attempted, can, in an economical point of view, successfully compete with the sulphuric saponification.

* * * *

593*b* AUSTRIA.

Page 5.—Sarg. F. A. Leising, near Vienna, exhibits stearic acid from aqueous saponification, (pressure of 12 atmospheres;) two qualities of glycerine, of which one is nearly colorless and chemically pure—and glycerine soaps.

Soap Manufacturers' Company, Vienna. This association exhibits stearic acid obtained from water saponification, (pressure of 10 to 12 atmospheres.)

MEDALS.—UNITED STATES.

Page 7.—Tilghman, for fatty acids obtained by aqueous saponification. * * *

Report of examiner.

EXAMINER'S ROOM, No. 2,
U. S. Patent-Office, Nov. 23, 1867.

To the Commissioner of Patents:

I have the honor to submit the following report in the matter of the application of R. A. Tilghman for extension of patent granted to him Oct. 3d, 1854, antedated January 9th, 1854, for process of purifying fatty bodies.

The invention in this case consists in separating what are known as fat acids from glycerine, by heating fats, animal and vegetable, with water at a high temperature. The result is the production of a solution of glycerine in water and solid fat acids, which may be used for the manufacture of candles and other purposes.

The glycerine may also be concentrated and purified.

The novelty of the invention has been fully sustained by verdicts in two suits in the United States courts; also by the scientific juries in the London International Exhibition of 1862, and in that of Paris of 1855.

The novelty of the invention is therefore not questioned. The utility of the invention is also fully shown by the testimony filed in the case. The value to the public is proved to be over one thousand dollars per day.

594 The invention, though both novel and useful, did not yield any return worth mentioning, until within the last two years of the period for which the patent was granted.

* Specimens of which are exhibited in the American Department.

The invention required a total change in the established process of decomposing fats for the manufacture of fat acids, and was therefore attended with considerable expenditure of money and time. As soon as the invention was well introduced infringers used it so as to make it necessary to appeal to the courts for protection.

This occasioned still further expenditure, which consumed nearly all the profits derived from the patents up to within two years of the expiration of the patent.

Since that time the patent has yielded a fair return, but not sufficient to cover the previous twelve years, during which almost nothing was saved over and above the necessary expenditure.

There is no opposition to the extension of the patent. Nor is it believed that the public interest would be affected injuriously by granting the extension.

The invention I regard as one of great value to the public, and believe that the petitioner has fully complied with all the conditions to entitle him to an extension of his patent.

I therefore recommend that the extension be granted as prayed for.

B. S. HEDRICK,
Examiner.

595 Circuit court U. S., southern district of Ohio. In equity.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz.

DEFENDANTS' TESTIMONY.

[The Leisenring Printing House, 237 and 239 Dock street, Phila.]

596

597 Circuit court of the United States, southern district of Ohio.

RICHARD A. TILGHMAN
against
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz. } In equity.

To the complainant and his counsel:

You will please take notice that an examination of witnesses in the above cause will be had, on the part of the defendants therein, in the city of New York, on Thursday, the 20th day of May, 1869, at the office of R. G. Mitchell, No. 168 Pearl street, before Charles H. Kitchel, esq., a notary public in and for said city.

Such examination will commence at 1 o'clock p. m. of said day, and will be continued from day to day until concluded.

Yours, &c.,

CHA'S B. COLLIER,
Solicitor for Defendants.

Dated Philadelphia, May 17th, 1869.

Service of the above notice is accepted, and objections as to time are waived.

B. C. TILGHMAN,
For George Harding, Solicitor for Complainant.

598 Circuit court of the United States, southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz.

Depositions of witnesses taken on behalf of the defendants in the above-entitled cause, before me, Charles H. Kitchel, a notary public in and for the city and county of New York, commencing on the 20th day of May, A. D. 1869, and continued by adjournment as hereinafter noted; the same having been taken at No. 168 Pearl street, in said city, pursuant to notice hereto attached. Present, Charles B. Collier, esq., counsel for defendants, and B. C. Tilghman, esq., counsel for complainant.

ROLAND G. MITCHELL, being first duly cautioned and solemnly sworn, deposes and says:

Question 1. Where do you reside, and what is your occupation?

Answer. I reside in the city of New York, and am a manufacturer of fatty acids and glycerine.

Q. 2. For how long have you been engaged in the manufacture of fatty acids and glycerine, and by what processes have you manufactured such products?

A. I have been a manufacturer of them for about eighteen years; part of the time by the saponification or lime process, and part of the time by water without lime.

Q. 3. How extensively have you manufactured fatty acids and glycerine?

A. We convert about 40,000 pounds of neutral fat into those products weekly.

Q. 4. Have you read the letters-patent granted to Richard A. Tilghman, the complainant herein, on the 3d day of October, A. D. 1854, entitled "A new and useful improvement in processes for purifying fatty bodies?"

A. I have.

Q. 5. How often?

599 A. Hundreds of times.

Q. 6. What do you understand to be "the improvement in processes for purifying fatty bodies," described and claimed in the said letters-patent?

A. The process described is to subject the neutral fat to the treatment of water under pressure, and consequently in a closed vessel, so that no steam could form, to a temperature of about melting lead, stated to be 612° F. The patent states that the fat should be subjected to this treatment for ten minutes, to obtain the desired object. As it is a patent for improvement in processes for purifying fatty bodies, I suppose it was intended to purify them of their glycerine, which at that time was a worthless product.

Q. 7. How many forms of apparatus do you find described in said patent for performing said process?

A. There are two forms of apparatus, one, any convenient vessel; the other, a tube or continuous channel; but, as they were both to be heated to the same temperature, neither could be any larger than a small pipe to resist the pressures called for by the patent.

Q. 8. If you were called upon, as a manufacturer, to perform or put

in practice the said patented process, with the letters-patent as your guide, what difference, if any, would you allow for steam-room in the use of the "coil-apparatus," or "continuous channel," in the one case, or "any convenient vessel," in the other? And if you would allow no difference for steam-room, give your reasons.

A. I should never think of putting in operation such a process, as a manufacurer; but, if I were called upon to experiment, with the patent as my guide, I should use only one form of apparatus, which would be the "coil," or "continuous form," which has a valve at the end to admit of the expansion of the water corresponding to the temperatures named in the patent. After these temperatures were reached by loading that valve, the experiment could be performed as in any convenient vessel. By removing that pressure it could be performed continuously, as set forth in the second mode specified in the patent. But neither method could be practically used in manufacturing; neither could the re-
600 sults be obtained which were here called for by the patent. I know of no convenient vessel used in manufacturing, wherein a fatty body mixed with water could be subjected to the temperature of the melting-point of lead. It must necessarily have a valve to admit of the expansion of the water, and such expansion would necessarily carry off fat as well as the vapor of water, or the water itself; and in all experiments made with the "coil-apparatus," it was first filled with water until it attained the heat called for by the patent.

Q. 9. In the said letters-patent the following language occurs: "The process may be performed more rapidly, and also continuously, by causing the mixture of fatty matter and water to pass through a tube or continuous channel heated to the temperature already mentioned, the requisite pressure for preventing the conversion of the water into steam being applied during the process. And this, I believe, is the best mode of carrying my invention into effect." Following the language quoted is a description of the tube or "coil-apparatus." Will you please state what experiments, if any, you have made to ascertain the practicability of carrying said process into effect by the apparatus described by the patentee, as being the best mode, and with what result?

A. I have had such an apparatus constructed as called for by the patent, and endeavored faithfully to produce the results claimed for it therein without success. The fat, at the temperature of melting lead, was decomposed into fat acids, glycerine, and acroleine, the latter being caused by the decomposition of a part of the glycerine, rendering the whole of it worthless, and impairing the value of the fat acids. At lower temperatures the fat would not be wholly decomposed, which would greatly impair the value to candle manufacturers, by whom it is mostly used.

Q. 10. In the trials, how many efforts did you make to carry into effect the said process of the complainant, and in such trials were all of the conditions of the patent complied with?

A. I could not state the exact number of the trials, but there were a great many, and I endeavored faithfully to perform the operation under all the conditions called for by the patent.

Q. 11. In the said patent, referring to the "continuous channel," or "coil-apparatus," it is stated that the requisite pressure,
601 for preventing the conversion of the water into steam, should be applied during the process. Do you understand that the same condition must be observed in the practice of the process in the other form of apparatus referred to in the patent, viz, "any convenient vessel?"

A. Unquestionably so; for the patent states that the invention consists of a process of subjecting "fatty or oily bodies to the action of water," and the claim is "the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure.'

Q. 12. As a manufacturer in the branch of business to which the said letters-patent relate, will you please state the lowest temperature at which decomposition of fats, by the action of water, into fat acids and glycerine, takes place, as announced in the said letters-patent of the complainant, according to your understanding thereof?

A. The patent states, "the change of fatty matter into fat acid and glycerine takes place with some materials (such as palm-oil) at or below the melting-point of bismuth." Palm-oil is one of the softest and most easily decomposed of fats; consequently, it is my opinion that the melting-point of bismuth, 510° F., is the lowest point at which, in the opinion of the patentee, fats can be decomposed. I am confirmed in that opinion by his English patent, which bears the same date as the American, which states the degree of heat required for the purpose of manufacturing soap "is less than that which is necessary to produce free fat acids, and should generally be kept between the melting points of tin and bismuth."

(The counsel for defendants offers in evidence printed official copy of English letters-patent, No. 47, granted to Richard Albert Tilghman, sealed March 25th, 1854, and dated January 9th, 1854, marked "Exhibit A, Mitchell.")

Q. 13. Have you read, and do you understand, the processes practiced by the defendants for the decomposition of fats, as described in the original and supplemental answers in this cause?

A. I have read those answers, and believe I understand the processes.

602 Q. 14. Will you please state whether or not, in your opinion as a manufacturer, the processes so described in the answers of the said defendants, and practiced by them, are substantially the same in principle, mode of operation, and effect produced, as the process described and claimed in the letters-patent of the complainant, sued on herein; and if said processes of the defendants are unlike the process of the complainant, in your opinion, state the differences between the two.

A. There is not, in my opinion, the slightest resemblance between the processes of the complainant and of the defendants. The complainant's process consists in subjecting fat to heat, water, and pressure, at a temperature which will itself decompose fats into other products, without water or pressure. The process of the defendants consists in the treatment of fats at a lower temperature than that which will decompose them into other products, by the aid of lime and steam; neither of which are claimed in the process of the complainant. The processes of the defendants produce acids in combination with lime and glycerine, without acroleine; the process of the complainant produces free fat acids, glycerine, and acroleine. The process of the defendants is much nearer that described in a patent to the complainant, issued in 1860, in which it is stated, "As fat and water dissolve each other to a very slight extent, their action upon each other is much accelerated by large surface of contact." "The extensive surface of contact of the oil and water can be obtained by other means than the shallow copper water-trays above mentioned. A mass of water-soaked coke, or other inert body, can be used, producing a very extensive surface to be moistened by the water." It will be seen from this patent, that the complainant recog-

nized the necessity of the pressure of an alkali, to aid in holding the water in contact with the fat, or of some other means to produce the same effect, "and give an increased surface of permanent contact" between the fat and water; no such means were provided in the original patent of the complainant, which claimed to decompose fats by heat, pressure, and water only, while the means pointed out in the second patent take nearly as many hours as the first did minutes.

Q. 15. Do you know of any person in the United States other than yourself, who manufactures free fat acids and glycerine from fats by the action of water without the aid of lime?

603 A. I do not.

Q. 16. By what process do you manufacture free fat acids and glycerine, and is such process a patented one?

A. I manufacture under a process patented to Wright & Fouché, in France, in 1857, and subsequently in this country, 25th January, 1859. The process consists in recognizing the fact stated in complainant's patent of 1860, that fat and water dissolve each other to a very slight extent, and that their action upon each other is much accelerated by a large surface of contact. I produce its contact by having two boilers, one placed above the other, and connected with each other; the lower boiler is filled with water, and a portion of the upper boiler. Upon the water in the upper boiler is placed a layer of fat. Upon the application of heat to the water in the lower boiler, steam is conveyed to a vacant space in the upper boiler, in contact with the fat therein. As the pressure is increased, the steam condenses, falls down through the fat into the lower boiler, where it is again heated, and re-ascends, thus producing an automatic circulation of moisture through the fat, until it is dissolved into fatty acids and glycerine. The heat we use is about 374° F.—corresponding to a pressure of 180 pounds to the square inch.

Q. 17. To what other process, if any, are the fatty acids so produced subjected prior to being made into candles?

A. Water is never found pure in nature. The most universal impurity being lime—fatty acids having a great affinity for lime, combine with any lime present in the water, and to free the fatty acid from this impurity we treat it with a small quantity of sulphuric acid to purify it before making it into candles.

Q. 18. Where were the trials made by you with the "coil-apparatus," as described in the complainant's patent?

A. They were made at my works in the city of New York, and in Cincinnati at the works of George Shillito.

Q. 19. Have you read the Defendants' Exhibit No. 1 in this case?

A. I have.

Q. 20. In said exhibit it is stated as follows: "Fat changed in Perkins' engine;" and again, "Change of fat in Perkins' engine by water, heat, and pressure." Having, as stated, read said exhibit, will

604 you please state into what, in your opinion as a manufacturer, the fat in Perkins' engine, described in said exhibit, was changed—whether into a lime-soap, a fat acid, or a mixture of lime-soap and fat acid, or either of these products?

A. I have already stated that lime is almost universally found in water. The treatment of fat in the Perkins engine, by water, heat, and pressure, would necessarily acidify some portion of the fat, and that portion would combine with any lime found in the water. That all the acids of the fat were not so combined with lime, is shown by the analysis made by Professor Faraday, who obtained what he said "resembled Chevreul's acids of fat," by its solubility in alcohol, which will not dis-

solve a lime-soap. He also states that it readily dissolves in alkalies, which is also a test of a fat acid. From my knowledge of the action of water upon fat, at the heat and pressure said to have been used in Perkins' engine—from 500° to 700° F., when the pressure was supposed to have been 2,000 pounds to the square inch—I can have no doubt whatever that fatty acids were formed, some of which may have been in combination with the lime found in the water.

Q. 21. Exhibit 1 says: "It is not soluble in ether, or very slightly so." Can you refer to any chemical authority, in which insolubility in ether is stated to be a characteristic of a fat acid? If so, will you refer to such authority and quote therefrom?

A. In Booth & Faber's translation of Regnault's Chemistry, edited, with notes, by James C. Booth and William L. Faber, published in Philadelphia, in 1860, on page 686, section 1593, I find the following statement: "Stearic, margaric, and oleic acids are weak acids, which are displaced from their compounds by a majority of the other acids, and they are insoluble in water, but soluble in alcohol, and very feebly in ether."

Q. 22. Will you refer to that portion of Exhibit 1, commencing with the words "the milky water," and ending with the words "diffused through it," being the last paragraph of said exhibit, and state whether, in your opinion, the substance which is spoken of as being "filtered through good filtering-paper," and called the "altered fat," was a lime-soap or a fat acid?

605 A. Neither a lime-soap nor a fat acid could, in my opinion, be so filtered. The altered fat was left on the filtering-paper after the other substances were separated from it, and was undoubtedly a fat acid.

Q. 23. What was it, according to your understanding and reading of said exhibit, that was filtered through "good filtering-paper?"

A. The previous paragraph in this exhibit states: "The softer portions, from the surface of the water, were found to contain a quantity of unchanged fat and oil. The milky water, on examination, was found to be a mixture, probably, of this substance and water." The filtration, in my opinion, caused a separation between the water and unchanged fat, and the fat acids, the latter of which remained upon the filtering-paper.

Q. 24. Exhibit 1 says: "The milky water, on examination, was found to be a mixture, probably, of this substance and water. It undergoes no change in appearance, when left for many weeks," &c. * * * * "The finely-divided state of the substance, its solidity, and its near approach to the specific gravity of water, will, perhaps, account for the length of time during which it will remain uniformly diffused through it." Are the properties of this substance thus described, the properties of fat acids or of lime-soap?

A. In my opinion it was not a lime-soap, nor was it a fat acid; but it was a mixture of fat acid, neutral fat, and water. I am confirmed in this opinion, from a statement in a previous paragraph of said exhibit which states: "The water, as it issues from the end of the ejection-pipe into the tub placed to receive it, and from which it is pumped up again into the generator, appears white and translucent, and after having been used some time, very much resembles thin milk."

Q. 25. Taking said exhibit in its several parts, what inference, if any, or knowledge would you, as a practical manufacturer of fat acids and glycerine, derive therefrom; and what inference or knowledge would you, at any time prior to the date of the complainant's patent, have derived therefrom, if you had then read said exhibit?

A. I have no hesitation in stating, from the remarkable resemblance between the process of the complainant and that of Perkins, that
606 the products are identical, and that no manufacturer of fatty acids could have doubted that they were produced in the generator of Perkins. That generator was filled with water and heated by a furnace. A mixture of fat and water, very much resembling thin milk, was made in the cylinder by the piston and condensed steam. That mixture was driven by a force-pump into and through the generator, which was kept full of the mixture. The result of this process was found floating on the water, which, when collected, formed a soft solid. By long exposure to the decomposing action, it became hard, like wax nearly. It is rather lighter than water, dissolves readily in alkali, and, in this respect, resembles Chevreul's acids of fat, as well as in its solubility in alcohol.

Adjourned at the same place to 11 a. m., on the 21st May, 1869.

FRIDAY, *May 21st*, 1869.

Examination of R. G. Mitchell resumed:

Present, Charles B. Collier, on behalf of the defendants, and Richard A. Tilghman, complainant, in person, and his counsel, B. C. Tilghman, esq.

Q. 26. What is the appearance and consistency of your solution of glycerine, as it comes from your apparatus, in the dissolving or decomposition of fats by heat, water, and pressure?

A. The appearance is that of thin milk, and its density is about 4° Beaumé.

Q. 27. What is this appearance caused by; and may not the same causes have produced the same result in Perkins' engine?

A. The appearance is caused by the suspension of particles of fatty acid in the solution of glycerine, and undoubtedly like causes would produce like effects in Perkins' engine, or anywhere else.

Q. 28. In the evaporation of the water from the glycerine solutions, resulting from your process, what products do you obtain?

607 A. I have never analyzed those products, but from their appearance and consistency, and the sources from which they are derived, I have no doubt they consist of glycerine, fat acids, and impurities of the fats and water that generate the glycerine. In the evaporation a thick, black scum rises to the surface.

Q. 29. How does the appearance of this watery solution, resulting from your process, correspond with the "milky-water" solution described in Exhibit 1?

A. I think it resembles it exactly.

Q. 30. Have you read Defendants' Exhibit No. 9? If so, what fact is made known by said exhibit, as understood by you?

A. I have read said exhibit, and learn therefrom that water will decompose fat into acids and glycerine at the ordinary temperature and pressure of the atmosphere.

Q. 31. In said exhibit it is stated as follows: "Upon examining the oil upon the surface, we found that it had undergone a very remarkable change. It was nearly covered with large clots of a mucilaginous-looking substance, which in places reached quite through to the water beneath, so that upon moving them aside, the latter was uncovered. Upon the top of this, in various parts, were drops of an aqueous fluid, of a tenacious consistence, which had a very decided sweet taste, and resembled the substance which is formed during the process of saponi-

fication, to which the name of glycerine has been given." Will you state what, in your opinion, from the description given, this substance was?

A. There can be no reason to doubt that it was glycerine.

Q. 32. And if it was glycerine, what other product was present in addition to glycerine?

A. Glycerine is the base of fats. It does not exist in fats as such, but requires the agency of moisture to generate it. When formed, the other constituents of the fat are necessarily acid.

Q. 33. Would any manufacturer of fat acids and glycerine, in your opinion, infer, from said exhibit, the decomposition of the castor-oil, named in said exhibit, into fat acids and glycerine?

A. I should have no doubt of it.

Q. 34. Is it not a law, well understood by all manufacturers, that increase of temperature facilitates processes of decomposition?

A. Heat and moisture are the great decomposing agents in
608 nature, and as the heat is increased decomposition is accelerated. At a temperature below the freezing-point, I believe, it is arrested.

Q. 35. Exhibit 9 further states: "We next examined the portion of oil and water which had been set by in a glass vessel, for the purpose of watching any changes which it might undergo at the point of contact with the water. It appeared to have undergone change, and to be separated from it by a tough film of the same mucilaginous-looking substance which we had found in the boiler." What change, in your opinion, had this oil "undergone," and what was the cause of such change?

A. The change was undoubtedly the same as that which took place in the barometer, but only less in degree. The water in the barometer was constantly agitated by the variation in the pressure of the atmosphere, and it is well known that motion exercises considerable influence in chemical forces. The change was caused by the water, as is clearly shown by the lower surface of the oil being more affected than the upper.

Q. 36. If, as a manufacturer of fatty acids, you had read, prior to the date of the complainant's patent, this Exhibit No. 9, what inference or knowledge would you have derived therefrom, if any, as to the reaction of water upon oils or fats?

A. As I have known, for more than forty years, that fats and oils were acidified by moisture, I should have had no doubt whatever of the character of the change mentioned in the exhibit—that it was a change from a neutral fat to fatty acids and glycerine.

Q. 37. Aside from the portion of fatty acids which are mixed with the glycerine solution resulting from your product, where is the remainder of the fatty acids found, and in what condition, at the conclusion of your process?

A. After they are taken from the apparatus in which they are dissolved, they are found in a crystalline condition, and if allowed to cool in the apparatus they would be found to be above the surface of the water containing the glycerine solution.

Q. 38. In what sense do you use the word dissolved in your last answer?

A. The complainant, in his patent of 1854, claimed, as his invention,
the manufacturing of fat acids and glycerine from fatty bodies
609 by the action of water at a high temperature and pressure. He stated, in that patent, what those high temperatures and pressures were—which temperatures will of themselves change or decom-

pose fats into other products. He subsequently, in 1860, took out another patent for another process, in which he says: "As fat and water dissolve each other to a very slight extent, their action upon each other is much accelerated by large surface of contact." In this last patent he provides for the use of alkalies to aid in dissolving the fat, which, in his English patent, he states require a less heat than when water alone is used. I therefore use the word "dissolve" as being applicable to the change of fats into fat acids and glycerine, when a less heat is required than will of itself decompose them into other products.

Q. 39. In any process wherein fats are dissolved or decomposed by the action of water, heat, and pressure without the use of lime or other alkali, in what state of admixture would the resulting products be found at the conclusion of the operation?

A. They would be found, as I have before stated, as crystallized fat acids and glycerine in solution.

Q. 40. Is that the character of the products resulting from the processes of the defendants, as described in their original and supplemental answers in this cause?

A. Most certainly not; for the defendants use lime in their process, which lime combines with the acid of the fats, and forms a lime-soap, and also aids in dissolving the other portions of the fat into acids and glycerine, in which, undoubtedly, more or less of the lime is found in suspension.

Q. 41. If, as claimed by the complainant, a portion of the fat treated in defendants' processes is decomposed into free fat acids and glycerine by the sole agency of water, where would such free fat acids be found at the conclusion of the operation?

A. I do not think there would be any free fat acids formed. They would be free in one sense, because they would not be chemically combined with the lime; but I think the lime would exert such an influence upon them that they would be mixed with it and with the lime-soap. If the acid was entirely free, it would be found upon the surface of the water.

Q. 42. From the condition of admixture of the water, fat acids,
610 and lime, resulting from the defendants' processes, what inference, if any, do you derive as to the influence of the lime upon the fats; in other words, is its influence exerted upon a part of the fat, or upon the entire mass?

A. It is my opinion that lime exerts no influence whatever upon neutral fats. When lime is placed in contact with water it becomes hydrated, and, in that state, holds the water in contact with the fat until the water acidifies the fat, when the lime combines with it. The complainant, in his patent of 1860, suggests that a mass of water-soaked coke, or other inert body, can be used to produce a very extensive surface to be moistened by the water. The influence of the lime is exerted to hold the water in contact with the entire mass of fat.

Q. 43. Have you any knowledge as to whether or not steam will decompose fats into fat acids and glycerine?

A. I have, both from reading and observation. The vapor of water is chemically the same as water itself, and its action upon fats identical at the same temperature in the production of fat acids and glycerine.

Q. 44. In the defendants' processes, it is stated that their digesters, after the fat and milk of lime have been placed therein, are only about three-quarters full; and that, then, superheated steam is forced into the bottom of the digesters during the continuance of the operation. From

your knowledge as to the effect of steam, what influence, in your opinion, does it exert in the defendants' processes?

A. I have already stated that the action of steam and water upon fats was identical at the same temperature. The more finely-divided state in which the water can be brought into contact with the fat, the greater, in my opinion, will be its power in dissolving it into acids and glycerine; consequently, it is my opinion that the superheated steam used in defendants' processes exerts the same influence that the same quantity of moisture would in any other form.

Q. 45. Will you please examine Defendants' Exhibit No. 17, English letters-patent of David Walther, A. D. 1840, No. 8752, "for certain improvements in the methods of purifying vegetable and animal oils, fats, and tallows, in order to render those substances more suitable to soap-making, or for burning in lamps, or for other useful purposes,"
611 &c., and state what, in your opinion, would be the resulting products of such process, with the use, in connection therewith, of the same quantity of lime as employed by the defendants in their processes? Wherein, if at all, would the resulting products differ from the resulting products of defendants' process?

(Objected to by plaintiff's counsel.)

A. In my opinion, if the same quantity of lime was used in the Walther process, the results would be identical with those obtained by the defendants in their processes.

Q. 46. Where is the apparatus, known as the coil-apparatus, used by you in your efforts to carry into effect the complainant's process?

A. It is at my works, in this city.

Q. 47. Have you any objections to permitting its use for the purpose of repeating the experiments, with a view of determining the practicability of complainant's process?

A. I have no objections whatever, but it will give me great pleasure to have it so used, and have the complainant present to direct how it should be done, in accordance with the specifications in his patent.

(The counsel for the defendants now and hereby gives notice to the complainant, now present, and his counsel, that he will, in accordance with the permission of the witness, cause an experiment or test to be made with said apparatus at the manufactory of R. G. Mitchell, in this city, or at any other place which the complainant may prefer, with a view of determining the practicability of complainant's process; such test to be made under the supervision and direction of the complainant, or of such person as he may choose to designate for that purpose, and to be made at the expense of the defendants.)

Cross-examination by Benjamin C. Tilghman, esq.:

X Q. 48. Are you the defendant in the suit of Richard G. Tilghman, the complainant herein, against Roland G. Mitchell, in the circuit court of the United States for the southern district of New York; and was said suit brought for an alleged infringement of the same patent of said Tilghman, as sued on herein?

612 A. I am such defendant, and suit was brought for such alleged infringement.

X Q. 49. Is the printed paper, now produced, and marked Complainant's Exhibit Mitchell, No. 1, May 21st, 1869, C. H. K., a copy of the opinion of the court in said suit of Tilghman against Mitchell, to the best of your knowledge and belief?

(Objected to by counsel for defendants, for the reason that the same is not competent, pertinent, or relevant as evidence in this cause.)

A. It is not, in my opinion, a copy of the opinion of the court. Such an opinion may have been given; but, if it was, it was shown to be so unjust, or to work such hardship to me, that it was modified, so that an injunction should not be issued if I gave a bond in the penal sum of twenty thousand dollars, with one surety, to pay any sum which may be found due from me to the complainant. There is one remarkable provision in this decree, for which I cannot account. It is: "That the said complainant do recover of the defendants their costs, and charges, and disbursements in this suit to be taxed." Such a decree seems to me very much out of place.

X Q. 50. Are you largely interested in impeaching the validity of the patent sued on herein?

A. As it is necessary to the validity of the patented process of the complainant to show how it may be adapted to practical use, and it has been conclusively shown that it was not so adapted, and never has been used, all the interest that I have is to convince the court of the injustice of its decision.

X Q. 51. You, therefore, consider yourself as being entirely a disinterested witness in regard to the question of the validity of the patent sued on herein; is that so?

A. It is so to this extent, that my opinion, as far as I can judge, is entirely unbiased by any interest in this case.

X Q. 52. Have you not manufactured about eleven and a half millions of pounds, more or less, of fat into fat acid and glycerine by the Wright & Fouché apparatus and process, between the years 1860 and January 9th, 1868?

A. I believe I have.

X Q. 53. Does not the complainant herein claim, under the de-
613 cision of the court above referred to, to make you pay a large sum, say about $200,000, as profits derived from your said manufacture?

A. What the complainant claims, and what he is entitled to under the decision of the court, are very different things, in my opinion. Under that decision he is not entitled to one cent, although he may claim $1,000,000. I do not know what sum he claims.

X Q. 54. Do you know whether he claims anything?

A. I do know that he claims the profits which I have derived from infringing his patented process, which I also know are nothing.

X Q. 55. Do you not know that he claims to make you pay the value of about thirteen and a half per cent. of lime, and twenty-seven per cent. of sulphuric acid, and two per cent. of fat, calculated on the eleven and one-half million of pounds of fat so manufactured by you?

A. I do not; nor do I believe that he expects to recover any such amount.

X Q. 56. Did you ever see a printed paper, purporting to be an argument of counsel for complainant in the suit against you, in which any sum whatever was claimed?

A. My counsel sent me an anonymous printed paper, purporting to be an argument of counsel for complainant, which he stated was so like the story of Munchausen that he supposed it was not intended to be believed.

X Q. 57. Was any sum claimed in said paper; if so, what sum?

A. I think the sum claimed in said anonymous printed paper was about $200,000.

X Q. 58. Did you ever see the letters addressed to G. C. Goddard, esq., your counsel, as follows, or were you made acquainted with their contents?

COMPLAINANT'S EXHIBIT, APRIL 13TH, 1864.

TILGHMAN
vs.
MITCHELL.

1123 SPRUCE STREET,
Philadelphia, April 13th, 1864.

614 SIR: On the 5th instant, I mailed to you the notice of which the following is a copy, requesting the favor of an answer within five days. For fear that you did not receive it, I now send this copy of my former note, requesting the favor of an answer accepting or declining my proposition within five days after your receipt of this present notice, inasmuch as I have other engagements to which I wish to attend. I would also thank you to acknowledge the receipt of my former notice, if received by you.

Very respectfully, yours,

R. A. TILGHMAN.

G. C. GODDARD, Esq.,
17 *William Street, N. Y.*

EXHIBIT, APRIL 13TH, 1864.

(Copy.)

TILGHMAN
vs.
MITCHELL.

SIR: The only objection which complainant had to the repeating of his experiments on the coil-apparatus was the risk of delaying the hearing to the next term.

As the court has ordered that the case shall still be heard this term, though at a later day, the complainant now offers to repeat the experiment tried by Professors Booth, Rogers, and Bridges, in the presence of the defendants, and requests the defendant to signify his acquiescence or refusal of this proposition within five days. If accepted, the complainant will at once have his apparatus put in order, and then appoint the earliest day which may be convenient to both parties for the defendant to visit the complainant's laboratory in Philadelphia, and see the process in action.

Very truly, yours,

R. A. TILGHMAN.

G. C. GODDARD,
17 *William Street, N. Y.*

APRIL 5TH, 1864.

615 SOUTHERN DISTRICT OF NEW YORK,
City and County of New York, ss:

Edward Osborn, of said city, being duly sworn, says that on the 14th day of April, 1864, he served a notice, of which the foregoing is a copy, upon George C. Goddard, esq., solicitor, and of counsel for defendants

in the above-entitled suit, by delivering said notice to him, and leaving the same with him.

Sworn to before me this 22d day of April, 1864.

EDWARD OSBORN,
Per JAMES GAGE,
Notary Public, City and County New York, 335 Broadway.

NEW YORK, *April 15th*, 1864.

Mr. R. A. TILGHMAN.

DEAR SIR: Yours of the 13th is received, as was yours of the 4th or 5th, to which, I think, I made answer.

After the use of your coil-apparatus by us was declined by you, we made arrangements which we hope will supersede the necessity of making experiments on yours. Should we change our minds and desire to experiment on yours, we will advise you; but at present we do not.

Yours, truly,

GEORGE C. GODDARD.

A. I do not recollect of ever having seen the letters, or of having been made acquainted with their contents, until I saw them printed some time in 1864.

X Q. 59. Were you aware that the offer contained in said letters had been made to your counsel before the hearing of the suit against you?

A. I have no recollection of it: but I have no doubt that it was made.

X Q. 60. Have you any doubt that said offer was communicated to you by your counsel shortly after it was made to him?

616 A. I have good reasons for believing that my counsel did not communicate such offer to me, from the fact that he was aware that the complainant had objected to repeating his experiments on the coil-apparatus in my presence, and my counsel was aware that I was preparing a coil-apparatus of my own to experiment with, as he stated in a letter published on page 137 of the same printed evidence before referred to addressed to complainant.

X Q. 61. Did you authorize or approve the letter of your counsel, G. C. Goddard, to complainant, dated April 15th, 1864?

A. I have no recollection of either authorizing or approving such letter, or of knowing that it was written at that time: but it is such a letter as I should probably have written in reply to the complainant's proposition.

X Q. 62. Did you ever at any time, from the date of those letters up to the present day, communicate to the complainant a desire to see his apparatus in action?

A. I cannot answer that question without giving a false impression, unless by stating that immediately after testimony had been given that such apparatus had been successfully worked or operated in the city of Philadelphia, so satisfied was I that that testimony was untrue, that I requested that the experiment should be repeated; which request appears on page 89 of complainant's printed evidence, in the following words: "The defendant requests the opportunity of performing an experiment or experiments on the coil-apparatus used by the complainant in his experiments which have been testified to, at which the defendant may be present, to which he will attend as early next week, after Monday, as may suit complainant's convenience, in Philadelphia." This request was made on the 19th of March, 1864. On the 24th of March, 1864, the following answer was made to it:

"MARCH 24TH, 1864.

"Present, counsel for respective parties.

"In reply to the request, made at the adjournment on the last day of taking testimony, by the defendant for the use of the coil-apparatus to experiment with, Mr. Tilghman replies, that the coil-apparatus is very weighty and bulky, and was dismantled, at the request of Profes-
617 sors Booth and Bridges, the day after the experiments therewith were tried by them, in order to enable them to examine its interior construction and dimensions. That to get the coil-apparatus again in working order, and try new experiments, would require considerable time, and delay the hearing. That the defendant neglected to make his request until the moment of adjournment on the day originally fixed to close the testimony; that the complainant has, however, caused the same experiments to be repeated in a more portable apparatus, which he produces and marks Exhibit Digester, and now formally offers to experiment with it and try any pertinent experiment in the presence of the defendants, on Friday, March 25th, at any suitable place and hour which defendants will now indicate, it being understood, also, that such experiments tried before defendants are not to be permitted to delay the hearing."

After my coil-apparatus was completed, I gave notice to the complainant, and requested him to be present at its working. He visited my works and saw the apparatus, but refrained from being present when it was tested. From these facts it will be seen I had no cause to desire to see the complainant's apparatus in action, and did not from the date of those letters request it.

X Q. 63. Referring to Defendants' Exhibit No. 1, does it contain, in your opinion, a plain, distinct, intelligible statement of the fact that fatty acids can be produced from fatty substances by the action of water at a high temperature and pressure?

A. When I was negotiating for the right to use the Wright & Fouché patent the question arose in my mind relative to the validity of that patent. I consulted with my partner, Mr. Florence Verdin, on that subject, and he informed me that long prior to the date of complainant's patent he had found, by experiment with Wilson's tank process for the rendering of fats under pressure, that the fats were acidified to such an extent, that in moulding them into candles they dissolved the lead out of the pewter moulds, and destroyed them so rapidly that he made arrangements to have moulds made under his own supervision to supply those destroyed; that subsequently the defendant in this case, Mr. Werk, informed him that some German work had published a statement that water, under heat and pressure, "would do wonders" in the treatment of fats. By direction of Mr. Werk, Mr. Verdin had a
618 close vessel made, with which he treated fats by heat, water, and pressure, for the purpose of dissolving them into acids and glycerine; but, finding the process too slow to be practicable or profitable, he abandoned it. Under these circumstances I can have no doubt that, had the statements contained in Exhibit No. 1 been placed in the hands of Mr. Verdin, *that* he would have accomplished precisely the same results as are obtained by the process of complainant. Exhibit No. 1 contains the distinct announcement of the "change of fat in Perkins' engine by water, heat, and pressure:" that this change produced a substance resembling "Chevreul's acids of fat," but it does not contain a distinct, intelligible statement of how this effect is produced. By reference, however, to Exhibit No. 19, which contains a statement of the manner in which Perkins' generator is filled and heated, I think all the informa-

tion is communicated which is necessary to show that fatty acids can be produced from fatty substances by the action of water at a high temperature and pressure.

(The hearsay portion of the answer objected to by complainant's counsel.)

X Q. 64. I then understand you to say that, taking Exhibits Nos. 1 and 19 together, they do, in your opinion, contain a plain, distinct, intelligible statement of the fact that fatty acids can be produced from fatty substances by the action of water at a high temperature and pressure. Is that your opinion?

A. Such is my opinion.

X Q. 65. Then, in your opinion, the fact that fatty acids can be produced from fatty substances by the action of water at a high temperature and pressure, has been known to the public ever since the publication of Defendants' Exhibits Nos. 1 and 19. Is that your opinion?

A. It is.

X Q. 66. Is it your opinion that Exhibits Nos. 1 and 19 contain substantially all the information necessary to enable a manufacturer to produce fat acids from fatty substances by the action of water at a high temperature and pressure?

A. I think they communicate all the information of any value to a manufacturer of fat acids that is communicated by the patent of the complainant of 1854; and, as I have before said, there is a re-
619 markable resemblance between the two processes. One forms an emulsion of fat and water, which is pumped into a coil full of the mixture, so that no steam or air can form, and subjected to a decomposing heat. In Exhibit No. 1 the emulsion is formed by steam in the cylinder of Perkins' engine, which is condensed, and the water containing the emulsion is then pumped into his generator, which is also full, so that no steam or air can form. Neither method would be practically useful, and neither has been used to my knowledge by any manufacturer.

X Q. 67. I understand you, then, to say that, in your opinion, Exhibits Nos. 1 and 19 do not contain, substantially, all the information necessary to enable a manufacturer to produce fat acids from fatty substances by the action of water at a high temperature and pressure. Is that your opinion?

A. I do not mean so to state. It is my opinion that the information communicated in Exhibits 1 and 19 is sufficient to enable a manufacturer to produce fat acid from fatty substances by heat, water, and pressure.

X Q. 68. Is it your opinion, from Exhibits 1 and 19, that a mixture or emulsion of fat and water was heated in the generator of Perkins' engine to a temperature of "from 500° to 700° F., when the pressure was supposed to be 2,000 pounds to the square inch?"

A. That is my opinion. But fat is so much lighter than water, that it would immediately rise to the top of the water and be expelled into the cylinder, so that it might require to pass through the generator frequently to be wholly acidified.

X Q. 69. Are you acquainted with the properties of fat acids so as to be able to distinguish them when described?

A. That would depend very much upon the description.

X Q. 70. Do you form your opinion that the changed fat described in Exhibit No. 1 was fat acid from any direct statement to that effect, or from the description of the properties of that changed fat? If from direct statement, quote the statement.

A. I form my opinion from the facts, stated in Exhibit No. 1, that the fat was changed by "water, heat, and pressure." From the description that change was one from a neutral fat to an acid fat. The test that was applied by Faraday was similar to that employed by the Philadelphia experts in the former case of Tilghman vs. Werk.

620 In that case Professor Rogers testified as follows: "I read from page 18 of said printed testimony, 'In accordance with the well-established laws of chemical combination every base is capable of combining with an acid only, in definite and fixed proportions, and, when such base is combined with its acid, the acid can only be liberated in the free state by presenting to the base a stronger acid. The fact that alcohol, ether, chloroform, or benzole can respectively remove from the product of defendant a large percentage of free fat acids, conclusively demonstrates that those acids so removed had not existed in combination with any base, but were altogether in an uncombined or free condition.'" On page 33 of said printed testimony Prof. Booth testifies as follows: "By treating the alleged product of Werk with alcohol, which dissolves the fat acids and glycerine, but which does not dissolve lime-soap, I found that the dry product of Werk contained 56.52 per cent. of lime-soap. * * * The solvents above alluded to, viz, alcohol and benzole, have, therefore, merely dissolved the fat acids and glycerine, and left undissolved the lime-soap."

Adjourned, by consent, until May 22d, at 11 o'clock.

MAY 22D, 1869.

On the 22d day of May, 1869, the examination of R. G. Mitchell was resumed.

Present, Charles B. Collier, esq., on behalf of the defendants, and Richard A. Tilghman, complainant, in person, and his counsel B. C. Tilghman, esq.

X Q. 71. Do you consider that Professors Rogers' and Booth's methods of testing, as described in their depositions alluded to, were accurate, and do they agree with your own knowledge upon the subject?

A. I do; and they agree with my knowledge.

X Q. 72. If a fatty substance was given you to examine, how would you proceed to find out whether it was a fat acid, or a soap, or a neutral fat, or a mixture of these three substances?

A. If it would dissolve in hot alcohol and crystallize on cooling, I should be satisfied that it was a fat acid. If the substance re-

621 quired a stronger acid to separate any combination existing with the fatty body, I should be satisfied that it was in combination with some mineral substance. If the substance would dissolve in alcohol, I should be satisfied it was not a neutral fat.

X Q. 73. If the substance did dissolve in hot alcohol, and did not crystallize on cooling, what would be your inference as to its nature?

A. I would infer that it was a neutral fat.

X Q. 74. By the term alcohol, do you mean ordinary druggists' alcohol, containing about 85 per cent. of real or absolute alcohol, or do you mean alcohol of some other specific strength?

A. I mean the ordinary alcohol of commerce.

X Q. 75. In your answer to Question 72 you say, "if the substance would dissolve in alcohol, I should be satisfied it was not a neutral fat;" do you mean hot alcohol or cold alcohol in that answer?

A. I mean hot alcohol.

X Q. 76. Please examine carefully your answers to Questions 72, 73,

and 75, and state whether you perceive any contradiction therein and wish to correct it.

A. In my answer to Question 73, I should have stated that I would infer that it was a neutral fat held in suspension by a fat in combination with some mineral substance. If my recollection is correct, in treating what I suppose to be a lime-soap with alcohol, I dissolved some neutral fat from the substance. I do not remember whether the alcohol was hot or cold.

X Q. 77. If the fatty substance examined did dissolve in hot alcohol, and the solution, on cooling, made a deposit or precipitate, which deposit was not crystalline, what would you infer the fatty substance examined to be?

A. I could make no inference with regard to such a substance without an examination of it.

X Q. 78. What further examination would you make to ascertain its nature?

A. That would depend upon what I supposed it to be, from its color, its consistency, and other properties.

X Q. 79. Suppose that its color was dark, its consistency hard, and you suspected that it was either a neutral fat, or a fat acid, or a soap, and wished to ascertain which of these substances it was, what further examination would you make?

622 A. If I wished to ascertain for some practical purpose, I should probably submit it to a chemist not residing in the city of Philadelphia.

X Q. 80. Is this the best answer your knowledge on these subjects enables you to give?

A. Not knowing what the substances are, I do not profess to have any knowledge.

X Q. 81. Is your answer to Question 79 the best answer that your knowledge of the chemical properties of neutral fats, of fat acids, and of soaps, and of the methods of recognizing them, enables you to give?

A. If the color of the substance was dark, and such color was produced by contact with iron, I should infer that the iron was oxidized, and consequently the fat was acid. I should remove that color by treating it with muriatic acid. If it was hard and brittle and had not been in contact with iron, I should infer that it was a lime-soap, and treat it with sulphuric acid to test the correctness of my inference. I could not tell what other tests I should make unless I knew how the substance had been treated, or what its appearance or consistency was.

X Q. 82. Referring to your answers to Questions 77 to 81, if the fatty substance examined was dark and hard, and you had reason to suspect that it was either a neutral fat, or a fat acid, or a soap, or a mixture of these, and you found that it did dissolve in hot alcohol, and the solution, on cooling, made a precipitate which was not crystalline, what would you infer the substance examined to be?

A. I should infer that it was a combination of fats, fat acids, mineral and organic substances.

X Q. 83. Is fat acid soluble in ether?

A. I believe it is.

X Q. 84. Did you ever see any fat acid, or know of the existence of any, which is not soluble in ether?

A. I cannot bring to my recollection any experiment to test the solubility of fat acids in ether, but I have no doubt I have made such, or seen them made, and therefore believe as before stated.

X Q. 85. If all fat acids are soluble in ether, and if you found that a

fatty substance was not soluble in ether, you would be satisfied that it was not a fat acid, would you not?

623 A. I should be satisfied that it was not a free fat acid; but, as it is my opinion, based upon experiments with ether, which I have either made or seen made, I should also be satisfied that it was not a neutral fat, as that will be dissolved by ether.

X Q. 86. Is there any lime in the Croton water used in your Wright & Fouché apparatus, to produce fat acids from fat at a high temperature and pressure?

A. There is.

X Q. 87. Does this lime combine with a portion of the fat acid and form a lime-soap in the course of your operation?

A. I have no doubt it does.

X Q. 88. In what state is the rest of the fat acid which is not combined with the lime?

A. The quantity of the lime is so small that it makes no perceptible change in the appearance of the fat acid, any more than it does in the appearance of the Croton water. It is free fat acid in combination with the impurities of the water, whether they be of lime or any other substance.

X Q. 89. Is any of the fat acid formed in your process free, in a chemical sense: that is, not combined with or neutralized by lime?

A. A large portion of it is unquestionably free.

X Q. 90. Is not all of it free, except that portion which is chemically combined with and neutralized by lime, or some other base?

A. It undoubtedly is.

X Q. 91. Suppose a quantity of lime equal to one-half per cent. or one per cent. of the fat was present with your water, would that lime also combine with a portion of the fat acid and form lime-soap?

A. It undoubtedly would.

X Q. 92. And the remainder of the fat acid not combined with and neutralized by lime would be, in a chemical sense, free, would it not?

A. It would.

X Q. 93. If still more lime were present, say from four to six per cent. of the fat, what would be the result?

A. More lime-soap would be formed, and there would be less of the acid free.

624 X Q. 94. Suppose twelve or fourteen per cent. of lime were present, what would be the result?

A. It would combine with all the fat acids and produce a lime-soap, and there would be no fat acids in a free state.

X Q. 95. Would not the same kind of combination of lime and fat acid, which you have described in your answers, 89 to 94, take place in any kind of a vessel or apparatus in which they were heated together with water?

A. It would.

X Q. 96. What is the melting-point of the fatty-acid product as it comes from your Wright & Fouché apparatus?

A. I do not recollect. It is probably about a hundred.

X Q. 97. In your experience as a manufacturer of fat acids, did you ever see fat acids that would not melt in boiling water?

A. Not unless they were in combination with some base.

X Q. 98. Did you ever see a free fat acid that would not melt in boiling water?

A. Not to my knowledge.

X Q. 99. When did you first see neutral fats decomposed into fat

acids and glycerine by the use of highly-heated water under pressure, knowing at the time that such a mode of decomposition could be used without the aid of chemicals?

A. I have known for more than forty years that fats were acidified by moisture. I never knew that the products mentioned, fat acids and glycerine, could be obtained from fats by heat, water, and pressure, until I heard of it in connection with the patent of Wright & Fouché, about 1859. Several years prior to that date the complainant patented an entirely impracticable and worthless process, which never has been used, because it cannot be, and the products obtained which he claims to produce, which I heard of previously to the date of the patent of Wright & Fouché's process.

X Q. 100. When did you first employ highly-heated water under pressure, at your factory, to decompose neutral fat into fat acids and glycerine without the aid of chemicals?

A. It was some time in 1860, in December of that year.

X Q. 101. Down to that time what agency had you employed to effect that which the decomposing power of highly-heated water under pressure has since effected at your factory?

625 A. The decomposing power of highly-heated water is not what has been used at my manufactory for the dissolving of fats into fatty acids and glycerine. At the heat and pressure I use, neutral fats cannot be dissolved into acids and glycerine so profitably as by the use of lime, which was the process used prior to 1860. By the aid of the circulation and contact of the fat and water produced in the Wright & Fouché apparatus, I am enabled to manufacture more cheaply than by the use of lime. Without such circulation and contact the lime process would be the cheapest. This, I think, the complainant fully recognized in his patent of 1860, which was three years after the French patent of Wright & Fouché.

X Q. 102. Prior to 1860 how many pounds of lime to one hundred pounds of fat did you use, and how many pounds of acid to each pound of lime?

A. From twelve to fourteen pounds of lime, and, I think, about two pounds of acid to every pound of lime.

X Q. 103. Did you use pressure in carrying on that lime process at your factory? If so, what was it?

A. We did not, excepting in the generation of steam, by which we communicated heat to our process of decomposition.

X Q. 104. Did you purchase the United States patent of Wright & Fouché in whole or in part?

A. I did in part. I bought the exclusive right for this State, for which I paid them $20,000; and if any revenue was derived from its introduction into other States of the Union, I was to receive one-half thereof.

X Q. 105. What saving is effected by this process over your old process that induced you to pay this price?

(Counsel for defendants objects to a continuance of this line of examination, for the reason that it is not cross-examination, and is not competent or relevant.)

A. We estimated the saving at the time of the purchase at about three-fourths of a cent a pound of the neutral fat. The saving would, of course, depend upon the price of lime and sulphuric acid, which, in a later estimate, made in 1867, I think the saving was estimated at nearly one cent a pound.

X Q. 106. Referring to the trials of the apparatus described in

626 your answers to Questions 9 and 10 in chief, can you state, of your own knowledge, whether the directions in complainant's patent were actually complied with?

A. I can, as far as my observation, knowledge, and belief go. It was my intention to faithfully comply with the specifications of the patent, and, as the best evidence thereof, I desired the complainant to be present at the working of the apparatus, so that any defects therein or variations from the patent should be pointed out and remedied. It is my thorough conviction and belief, as I have before stated, that it is an entirely useless and impracticable method.

X Q. 107. What was the character of the discharge of the material from the exit-valve of the coil-apparatus in your experiments? Was it steady and continuous, agreeing with the feed of the pump, or was it irregular and explosive—sometimes discharging considerable quantities rapidly, and then stopping altogether?

A. The discharges were not regular, corresponding to the action of the pump, but were intermittent. It is impossible, in my opinion, to have any regular discharge from such an apparatus. When the pressure on the exit-valve is sufficient to cause it to *raise*, steam is generated in the pipes, and a vacuum would be formed, or otherwise an absence of material in it, until the pressure was lessened so that the valve could again close. By reference to page 81 of complainant's testimony in my case, I find that Prof. Bridges testified as follows with reference to the coil-apparatus of complainant: "The flow was continuous, without any variation, except, perhaps, in rapidity;" which shows that the exit-valve was not sufficiently loaded to resist the pressure without reference to that produced by the pump; but it was rather a distillation under pressure. In my experiments the valve was so loaded that the discharges were sometimes large and sometimes small.

X Q. 108. After each of these large discharges the heated tube must have been partly empty of the mixed fat and water, must it not?

A. In complainant's patent of 1860 he states that a mixture of fat and water "is almost incompatible with a perfectly continuous form of
627 apparatus." If he had substituted the word "entirely" for "almost" it would have been correct. Such a mixture it is impossible to retain in the apparatus specified in his patent while it is being worked.

X Q. 109. Question 108 repeated.

A. Steam, in my opinion, necessarily formed in the apparatus after each large discharge therefrom, which it was impossible to prevent. In my opinion the fat and water separated immediately upon entering the apparatus. Fat, being so much lighter than water, would necessarily form on the surface of it.

X Q. 110. What was the character and consistency of the matter discharged from the exit-valve? Was it clear fat and clear water, or was it a mixture of fat and water?

A. At the temperature of melting lead it was a mixture of fat acids, glycerine, and acroleine, the latter entirely destroying the value of the glycerine, and impairing that of the fat acids. The water was more or less incorporated with these products, being cooled down after leaving the decomposing apparatus before they issued from the exit-valve thereof. At lower temperatures, submitted to the action for the same time, the fat would not be wholly decomposed, consequently there would be less acroleine and more of undecomposed glycerine; but at none of the temperatures named in the patent were fat acids produced without acroleine, and the consistency varied from a mushy mixture of acids and water to a more solid one.

X Q. 111. According to your rate of working of the pump in these experiments, what time was intended to be allowed for the passage of each portion of the mixture from the pump to the exit-valve?

A. The time called for in the patent of complainant, which is ten minutes.

X Q. 112. Was the same time allowed for the different experiments at all the different temperatures you employed in these experiments?

A. It was.

X Q. 113. I understand you, then, to say that the actual rate of working of the pump in your experiments was such as to allow ten minutes for the passage of each portion of the mixture from the pump to the exit-valve. Is that correct?

A. Such was the intention—that the fat and water should be subjected to the temperatures named in the patent for ten minutes.

628 X Q. 14. What was the actual rate of the working of the pump in proportion to the capacity of the whole tube? How much time did it allow for the passage of each portion of the mixture from the pump to the exit-valve?

A. I directed the pump to be worked so as to cause the mixture to be ten minutes exposed to the heat named in the patent. It was worked by the watch, and I have no doubt whatever that every direction in the patent was strictly complied with. I took no part in the construction of the apparatus, or in its working, excepting so far as was necessary to become thoroughly convinced that my instructions were complied with.

X Q. 115. Had your partner, Mr. Verdin, the direct superintendence of the working of your coil-apparatus in the experiments both in New York and in Cincinnati?

A. Not necessarily so. The apparatus was constructed under the direction of a very skillful mechanic in the employ of Van Horn & Co., machinists, of this city. Said mechanic was formerly employed by me as an engineer. The apparatus was worked under his supervision, and that of various other persons, Mr. Verdin being present both here and in Cincinnati.

X Q. 116. In his testimony in the suit of Tilghman against Mitchell, Mr. F. Verdin testified as follows—page 108 defendants' printed testimony—before a master: "6 Int. State what was the result of the experiments with the coil-apparatus in Cincinnati, and specifying the kinds of fat which you used, how prepared, and how introduced into the apparatus, the time of passage through the coil-pipes, the temperature to which it was subjected, and the nature of the products discharged from the apparatus." "A. It was bad. We used the best quality of tallow, and we melted and mixed it with one-third water, and mixed it well with an hydraulic force-pump through the coil heated up to melting-point of lead. It took us just ten minutes to pass the fat and water from the inlet to the outlet; and so we kept on with the operation until a gallon passed through. When we had it up to the melting-point of tin and bismuth the fat came out undecomposed, and when we got it above bismuth the fat was partly decomposed, and some of the glycerine, which was one of the products, was partly decomposed. When we got to the higher heat, the melting-point of lead, the whole of the

629 glycerine was decomposed into acroleine." And on page 122: "Cross-int. 66. In your sixth answer you state that in working the coil-apparatus in Cincinnati it took you just ten minutes to pass the fat and water from the inlet to the outlet. Did you regulate the time accurately by a watch?" "A. I watched the time." "Cross-int. 67. Did

you do this in the experiments in New York?" "A. I did." Does that testimony of Mr. Verdin correctly describe all the particulars stated; the details of said experiments, if incorrectly stated, in what?

A. On page 123, on cross-examination, said Verdin testified:—"On the starting-point, I filled the coil with hot water by the force-pump; then I kindled a fire under the apparatus, and heated my apparatus to the melting-point between tin and bismuth; after I had it at that heat, I commenced forcing the fat into the tube, and allowed the time it took to pass through the tube until it reached the heated apparatus. Afterwards, I counted the time until the first discharge of the water came through the valve, and that proved that the fat is ten minutes passing through the coil." From this I infer that the fat and water were subjected to the heat mentioned in the patent for ten minutes, when he states that at the melting point of tin and bismuth the fat came out undecomposed. I do not think he meant to state that the whole fat was in a neutral state. Mr. Verdin I have known for more than twenty years, and he is one of the most truthful, reliable men I ever knew.

Adjourned till the 25th of May, at 1 o'clock, same place.

MAY 25TH, 1869.

Cross-examination of Roland G. Mitchell continued:

Present, complainant and his counsel, Benjamin C. Tilghman, esq., and Charles B. Collier, esq., for defendants.

X Q. 117. What do you suppose, or infer, to have been the nature of the change of fat described in Exhibit No. 1?

A. It was changed into acids mixed with unchanged fat and oil.

630 X Q. 118. Did you ever see a mixture of fat acids with unchanged fat and oil that would not melt in boiling water?

A. Not to my knowledge; neither do I understand, from Exhibit No. 1, that the unchanged fat and oil mentioned in said exhibit would not melt in boiling water; but it was a mixed mass, "black and dirty," that would not so melt.

X Q. 119. What do you infer, or suppose, that "mixed mass" to have consisted of?

A. It consisted of fatty acids, the impurities found in the water, the impurities which those acids had dissolved out of the metals with which they came in contact—glycerine and acroleine.

X Q. 120. Do you suppose, or infer, that "mixed mass" to have contained any lime-soap?

A. As lime was found in the product, I should suppose it would have combined with the acidified fat, and have formed a lime-soap.

X Q. 121. The quantity of that lime-soap would be dependent upon the quantity of lime existing in the water used in the generator, would it not?

A. It would; but the acidified fat would combine with that lime, so that unless fresh water was constantly introduced into the generator there would be no lime therein for the fat acid to combine with. After the lime first found in the water had combined with the acid fat, the remaining portion of the acid would be necessarily free from combination with it.

X Q. 122. The whole of the lime existing in the water in the generator would combine with an equivalent quantity of the fat acid and form lime-soap, would it not?

A. That is my opinion.

X Q. 123. If, then, a quantity of lime sufficient to combine with all the fat acid had existed in the water in the generator, the product would necessarily have been lime-soap, without any mixture of free fat acid, would it not?

A. It certainly would; but Exhibit No. 1 shows, in my opinion, that the quantity of lime was not sufficient to combine with all the fat acid and form a lime-soap.

X Q. 124. It would depend then upon the quantity of lime existing in the water in the generator, as compared with the quantity of fat
631 used to "lubricate" the piston, to determine whether the product was only lime-soap on the one hand, or a mixture of lime-soap and of free fat acid on the other, would it not?

A. There is nothing in the exhibit to indicate that fresh water was supplied to the generator, while the piston was undoubtedly lubricated frequently. The acidified fat might therefore combine with all the lime in the water in the generator, and the fresh fat used in lubricating be left in the generator, as free fat acids.

X Q. 125. Question repeated.

A. An acid of fat combines with its equivalent of lime and forms a lime-soap. If the quantity of acid and lime were just equivalent to form a soap in the generator of Perkins, it would undoubtedly have been formed.

X Q. 126. And if the quantity of lime in the water had been largely in excess of the quantity equivalent to the fat acid, lime-soap, without any mixture of free fat acid, would have been produced, would it not?

A. If the quantity of lime in the water was more than sufficient to combine with the acidified fat, lime-soap, without any mixture of free fat acids, would have been produced.

X Q. 127. Exhibit 1 says: "A portion of this substance was digested in hot alcohol, and a clear solution set aside; flocculi separated in abundance from it on cooling, which, when dried, collected, and fused, gave a grayish substance, contracting and cracking as it cooled, with the lustre and appearance of wax, but rather more brittle." What do you suppose or infer to have been the chemical nature of this "grayish substance?"

A. Chevreul's acids of fat.

X Q. 128. What do you understand to have been the chemical properties of this "grayish substance?"

A. It had all the properties that Chevreul's acids of fat would probably have had, produced by heat, water, and pressure, in contact with iron and other metallic surfaces.

X Q. 129. Do you know anything of the properties of this "grayish substance," beyond what is mentioned in Exhibit 1?

A. I know, in evaporating our solution of glycerine, we obtain fat acids mixed with a great variety of impurities producing a scum
632 thick and repulsive in appearance. I have no doubt such a substance, digested in alcohol, would produce a "grayish substance," such as that mentioned in the exhibit, but I have never tried it.

X Q. 130. And you suppose and infer that "Perkins' scum" was the same as your scum, do you?

A. I have no doubt it had similar properties.

X Q. 131. What are the properties of the "grayish substance," as described in Exhibit 1?

A. The properties of impure fatty acids, as far as I can judge. The exhibit states "the cold alcoholic solution, on evaporation, left a substance similar in many respects, but much softer, even fluid."

X Q. 132. Question repeated.

A. As the substance is stated as capable of being dissolved by alcohol, separating into flocculi, with the lustre and appearance of wax, the properties described are those of impure fatty acids.

X Q. 133. Are these all the properties of the "grayish substances" which are described in Exhibit 1? If there are others, name them.

A. There are other properties described in Exhibit No. 1, as follows: Said exhibit says the "grayish substance" contracted and cracked as it cooled; that it did not melt in boiling water, but melted at a higher heat, and ultimately burned like fat; that it was rather lighter than water; that it dissolved readily in alkalies, and in this respect resembled Chevreul's acid of fat; that the alkaline solution was turbid; the "grayish substance" was not soluble in ether, or very slightly so; when burnt, it left an ash consisting principally of carbonate of lime.

X Q. 134. Of the chemical properties of the "grayish substance" which you have just enumerated, state particularly and in succession, which properties agree and which differ from the properties of Chevreul's acids of fat, according to the best of your chemical knowledge.

(Counsel for the defendants states that the witness was not called by the defendants as a chemical expert, nor examined as such, but as a practical manufacturer; but counsel for defendants does not object to the complainant's counsel making the witness his own chemical expert, if so desired by him.)

633 A. I have no doubt that a mixture of Russia tallow and olive-oil, subjected to water, heat, and pressure in such vessels as formed the engine and generator of Perkins, would produce the substances described in Exhibit No. 1. Those substances would consist of fatty acids, neutral fat, glycerine, and acroleine; they would be black and dirty from the impurities in the water and from oxidizing the iron and copper, which fatty acids will do. These chemical properties would agree so far with Chevreul's acids of fat, which also dissolves in alkali, and are soluble in alcohol, and when burnt leave an ash of carbonate of lime. I never saw any combination of fatty and other substances that did not melt in boiling water, but melted at a higher heat, and ultimately burned like fat; consequently in this respect the properties in Exhibit No. 1 differ from any with which I am acquainted. Fatty acids, I believe, are soluble in ether, and so are neutral fats. If the product of Perkins' engine was not soluble in ether, it could not, in my opinion, be a neutral fat.

X Q. 135. You say, "fatty acids, I believe, are soluble in ether." "If the product of Perkins' engine was not soluble in ether," could it be a fatty acid?

A. It could not, in my opinion, be a pure fatty acid, and the product is not claimed to be such. It is stated, "it is not soluble in ether, or very slightly so."

X Q. 136. What impurity would cause fatty acids "to be not soluble in ether, or very slightly so?"

A. The impurities found in the water used in Perkins' engine, and the metals of which it is composed, I suppose. I have no knowledge on the subject.

X Q. 137. Should you not suppose that the same impurities would also make it insoluble in alcohol?

A. That would naturally be my supposition, without having read or experimented on the subject.

X Q. 138. Did you ever consult Professor Wolcott Gibbs, Professor of Chemistry and Physics in New York Free Academy, on the subject

of the chemical novelty of the complainant's invention claimed in the patent sued on herein?

(Objected by counsel of the defendants, as being immaterial and irrelevant.)

A. I did so consult him, and was much surprised to be told by
634 him that he had already been spoken to on the subject by the complainant or his counsel, and I think he stated at the Union League Club in this city. The complainant afterwards examined him as an expert in his behalf.

X Q. 139. Did you receive from Prof. Gibbs a written opinion upon the chemical question submitted to him?

(Same objection by defendants' counsel.)

A. I did receive such an opinion, in which Prof. Gibbs states: "So far as the mere act of decomposition is concerned, I consider saponification by steam to be identical to saponification by water;" and, as Scharling saponified fats by steam long previously to the complainant's patent, I deemed the opinion of Prof. Gibbs as sound on that point, and unsound in ascribing the decomposition of Scharling to be produced by distillation, as a distilling heat was not used. A liquid during evaporation is said to communicate the power of assuming that state in a greater or a less degree to all substances dissolved in it, although those substances do not themselves possess that property. Boracic acid is said to be a perfectly fixed substance at a white heat, and therefore not volatile, but in contact with water it is evaporated at a very gentle heat, showing, what I have before stated, that motion exercised a considerable influence in chemical forces.

X Q. 140. Is the opinion of Prof. Gibbs, to which you have referred, and from which you quoted in your last answer, printed as an exhibit of the defendants on pages 246, 247, 248, as Exhibit 19, in defendants' printed record, in the suit of Tilghman vs. Mitchell?

(Same objection.)

A. It is.

(Complainant's counsel offers in evidence agreed copy of said opinion, and hereunto annexed, marked Complainant's Exhibit Mitchell No. 2. May 25th, 1869, viz:

OPINION OF WOLCOTT GIBBS.

The chemical points involved in the process of saponification are as follows:

1. Natural oils and fats are for the most part to be regarded as
635 compounds of oxide of lypil or glyceril, C^6, H^5, O^2, with three equivalents of a fatty acid. The fats most used in the arts are tri-stearates, tri-palmitates, and tri-oleates, and may be comprised under the general formula, C^6, H^5, O^2+3, equiv. acid. Saponification, in the more general sense of the term, consists—

First. In substituting three equivalents of water for the three of acid, so as to form glycerine, C^6, H^5, O^2+3 HO.

Second. In causing at the same time the three equivalents of fatty acids to unite with three equivalents of a base, other than oxide of glyceril or lypil. This base may be water, lime, soda, potash, or almost any other oxide.

2. Hence it is clear, that to decompose or saponify a natural fat or oil, in general six equivalents of base will be needed. All of these may be water. Then we shall have simply glycerine, C^6, H^5, O^2+3 HO, and three equivalents of a compound of fatty acid and water, such, for in-

stance, as three (C^{36}, H^{35}, O^3+HO) formed. This is what takes place in Tilghman's process, so called, when no lime or alkali is used. Or only three equivalents of water may be necessary. Then the other three equivalents of the six necessary must be some other base, such as lime, soda, or potash. In this case, also, we have glycerine formed, C^6, H^5, O^3+3 HO, and with this three equivalents of a soap, that is, of a compound of a fatty acid with a fixed base, such, for instance, as stearate of potash, C^{36}, H^{35}, O^3+HO.

3. We cannot in this process employ six equivalents of a fixed base, because the temperature required to decompose the oil or fat will be so high as to decompose the oxide of lypil, C^6, H^5, O^3, or the fatty acid, or both.

Hence it is clear that, practically, at least, three equivalents of water must be present in order to effect saponification. Tilghman's process required six. Chemically, the difference between Tilghman's process, so called, and the old process, consists in the amount or quantity of water required, which in Tilghman's process, so called, is twice as great as in the old or common process, and in the absence of fixed base, which in the old or common process is necessary, in consequence of the low temperature, comparatively speaking, at which the saponification is effected.

4. In the saponification by sulphuric acid introduced by Fremy, the sulphuric acid first unites with the stearine and oleine of the
636 neutral fat; cold water then separates glycerine, sulphuric acid, and compounds of the fatty acids with sulphuric acids, which are decomposed by water into free sulphuric acid and free fatty acid.

5. Berthelot (1) has shown that steam, at two hundred and twenty degrees centigrade, very slowly decomposes neutral fats into glycerine and fatty acids. Wilson (2) found that this decomposition takes place very rapidly at two hundred and ninety-three degrees C. Sharling (3) also observed the decomposition of fats by steam at a high temperature. Pelouze (4) found that steam decomposes fats at one hundred and sixty degrees to one hundred and sixty-five degrees C., in the presence of small quantities of lime. Bonis (5) found that in this case only one-fifth or one-sixth of the lime necessary in saponification by the ordinary process is required. De Milly uses the decomposition by steam, with one-third the usual quantity of lime under a pressure of five to six atmospheres, and at a temperature of one hundred and sixty-five degrees C., at most. In these cases the neutral fat yields only a neutral lime-salt, free fat acid, and glycerine. The influence of a small quantity of lime in facilitating the decomposition is very remarkable. Pelouze (7) finds that already formed lime-soap acts in the same manner. Pelouze (8) further showed that the presence of water is not indispensable for saponification by lime. Caustic lime (lime free from water) decomposes fats completely at two hundred and fifty degrees C., but in this case there is probably decomposition either of glycerine or of fatty acid.

6. I do not find that any one before Tilghman used water heated to a high temperature in a close vessel or boiler to decompose fats. I find that steam heated to a high temperature, with and without lime, has been used for this purpose; but that distillation in a current of steam at a high temperature is employed.

So far as the mere act of decomposition is concerned, I consider saponification by steam to be identical with saponification by water; but, on the other hand, I hold that decomposing fats by water in a close boiler at a high temperature is not, as a process, the same as distilling

the fat in a current of high steam, even though the chemical actions are the same in both cases.

This, perhaps, is a point of law rather than of science.

WOLCOTT GIBBS,
Professor of Chemistry and Physics in New York Free Academy.

637 Counsel for defendants inquires of complainant's counsel for what purpose and for what object said exhibit is offered in evidence. Counsel for complainant replies, for all purposes for which it is competent. Counsel for defendants waives all objections to said exhibit, but will claim the benefit thereof for all purposes for which the same is competent.)

X Q. 141. Were you present at the examination of Prof. Gibbs, as a chemical expert, for complainant in said suit of Tilghman vs. Mitchell, at Cambridge, in February, 1864?

A. I was.

X Q. 142. Was Prof. Gibbs, in that examination, asked by your counsel, Mr. Goddard, in your presence, whether he had not been, before that time, spoken to and professionally consulted in this matter by Mr. Tilghman, or in his behalf, and whether he did not so inform Mr. Mitchell?

(Objected to by defendants' counsel, as not being cross-examination, or competent for any purpose whatever.)

A. Having communicated to my counsel, Mr. Goddard, the day after I consulted Prof. Gibbs, the statement he made to me, that he had been spoken to by Mr. Tilghman, or his counsel, the question was asked by my direction.

X Q. 143. Did not Prof. Gibbs reply to that question, "No, sir; I had never been consulted by Mr. Tilghman, or by any person on his behalf. I never saw Mr. Tilghman till very recently?"

A. He did so reply, and that shows the fallibility of all human testimony.

Adjourned until the 26th, 11 o'clock a. m.

MAY 26TH, 1869.

Cross-examination of Roland G. Mitchell, esq., continued.

Present, complainant and his counsel, Benjamin C. Tilghman, esq., and Charles B. Collier, esq., counsel for the defendants.

X Q. 144. Referring to your answers to Questions 17 and 20
638 in chief, do you understand the lime which you mention as always existing in the "water found in nature," to be in the state of carbonate of lime?

A. I have no opinion or belief on the subject. I know that rain or other soft water dissolves an ordinary soap. I know that a hard water, or water impregnated with lime in some form, combines with that dissolved soap and forms a lime-soap. This, I suppose, is also the knowledge of every one who has washed in hard water.

X Q. 145. Does not a solution of free fat acid in alcohol give a red color to blue litmus?

A. I have no doubt it does.

X Q. 146. Is not blue litmus a test generally applied by chemists to ascertain the presence of any free fat acids in an alcoholic solution of a fatty substance?

A. I do not know.

X Q. 147. Was not that test applied by Chemists Doremus and Van

de Weyde, employed by you as experts in the suit of Tilghman vs. Mitchell?

(Objected to by defendants' counsel, as not competent.)

A. Not to my knowledge.

X Q. 148. Exhibit 1 states that the black, dirty scum was dissolved in hot alcohol, and a clear solution set aside. Would this treatment have the effect of separating from the impurities the free fat acids existing in said scum, if any?

A. Most unquestionably it would.

X Q. 149. Would this alcoholic solution contain in a purified state whatever free fat acid existed in the "black, dirty scum?"

A. It would not; and it is so stated in the exhibit, that it is a "grayish substance;" if pure, it would have been white.

X Q. 150. Apart from shades of color, would that solution have contained the free fat acids in a substantially pure condition, as compared with the original "black, dirty scum?"

A. It is very difficult to form an opinion of what the action of alcohol would be on a substance I never saw; but as that substance is said to have been produced by heat, water, and pressure in a neutral fat, changing it from its original consistency to that of a hard, wax-like substance, I can have no doubt that the alcoholic solution was free
639 fat acid, although I have somewhere seen it stated that a neutral oil contaminated with a portion of free fat acid, the whole may be dissolved in alcohol.

X Q. 151. Was the defendant in the present suit, M. Werk, and was Mr. George Shillito, examined as witnesses on your behalf in the suit of Tilghman against Mitchell?

A. I do not think they were. My impression is, that it was in the proceeding in opposition to the extension of the patent. Being shown copies of the proceedings before the master, I find they were.

Re-direct examination by counsel for defendants:

Q. 152. In complainant's exhibit, marked Mitchell No. 2, being opinion of Prof. Wolcott Gibbs, he says: "Scharling (3) also observed the decomposition of fats by steam at a high temperature." He says further: "So far as the mere act of decomposition is concerned, I consider saponification by steam to be identical with saponification by water." In complainant's patent, after stating the object of his invention, he says: "For this purpose I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain, at the same time, free fat acids and solution of glycerine." Will you please state wherein, if at all, the resulting products of the decomposition of fats by steam, as by Scharling, would differ from the resulting products claimed to be produced by the complainant's patented process?

A. There would be no difference whatever at the same temperature. Water and the vapor of water are chemically the same, and their action upon fats identical at the same temperature. This was shown by complainant, in the case of Tilghman vs. Mitchell, wherein he introduced the statement of G. F. Wilson, F. R. S., found on page 135 of the printed testimony in that case, as follows: "I went with my chemist-assistant, Mr. Payne, to see Mr. Tilghman's little apparatus at work, and in the course of some experiments which it led us to try, or rather to try over again, it struck me that steam, passed into the fat at a high tem-
640 perature, should effect, by a gentle process, what Mr. Tilghman aimed at effecting by a violent process—the resolving of the neu-

tral fat into glycerine and fat acids. We proved that this was so, and that the glycerine distilled over in company with the fat acids, but no longer combined with them." Mr. Wilson took out a patent for this process, which he said he extensively used, and which, as far as I can judge, is identically the process of Scharling. If this be so, it shows the process of Scharling to be a manufacturing one, while that of complainant was not, as it has never been used.

Q. 153. If Scharling, in 1850, decomposed neutral fats by steam, producing free fat acids and solution of glycerine as resulting products, what new discovery, if any, do you think was made by the complainant, and is announced in his said letters-patent?

A. I am not aware that the complainant claims in his patent to have made any chemical discovery. Such a claim would, in my opinion, be both presumptuous and preposterous. If he had made such discovery, it would have been announced in standard chemical treatises or books. I have searched for such an announcement, and have never been able to find any; and I know it was the opinion of Professor Gibbs that he made no such discovery.

Q. 154. Upon the hypothesis that the complainant, by his said patented process, is able to produce both free fat acids and solution of glycerine, what difference, if any, other than a mechanical one, exists between his said process and the process of Scharling?

A. If the steam from Perkins' generator had been allowed to remain in contact with the fat in his cylinder a sufficient length of time it would have decomposed it. The difference between that decomposition and that of Scharling would be one of pressure simply; that is the only difference between Scharling's process and complainant's. The first patent obtained for the decomposition of fats, by Gay Laussac and Chevreul, stated that a saponification made with a pressure of several atmospheres presented great advantages; consequently I infer that the process of complainant, if he could effect what he aimed to accomplish, would be only a different method of accomplishing the same re-
641 sults that Scharling had previously produced. This I infer the complainant was well aware of, because he restricts his process to the action of liquid water under pressure.

Q. 155. In your opinion of the three processes—Scharling's on the one hand and defendants' two processes on the other—which, in principle and results produced, is more nearly like the complainant's—upon the supposition that fat acids and glycerine can be produced by the complainant's process?

A. Complainant's process calls for no lime, but requires a heat that will itself decompose fats into other products than acids and glycerine, by the action of water alone. Defendants' processes both require steam and lime, with a less heat than called for by complainant's process; so that the resemblance between Scharling's process and defendants' processes is much greater than between complainant's process and defendants' processes—both in principle and in results produced.

Re-cross-examination by complainant's counsel:

X X Q. 156. In Scharling's process was the fat acid distilled over? Look at Defendants' Exhibit No. 12 and answer.

A. It was not; it was carried over mechanically by the evaporation of the water. A heat that would evaporate fatty bodies not being used, a liquid during evaporation communicates the power of assuming the same state, in a greater or less degree, to all substances dissolved in it. If the heat had been great enough to evaporate the fat, acroleine would

have been formed; and Scharling says "there was not the slightest trace of acroleine compound."

X X Q. 157. Then, in your opinion, Scharling was in error when he, in Exhibit No. 12, speaks, first, "of the acids distilled over;" second, "there was obtained on the distillate a mixture of fatty acids," &c., &c.; third, "in all these distillations," &c., &c.; is that your opinion?

A. As I have seen the process of Scharling practically tested, I know that a current of steam passed through fat, at the temperature he mentions, dissolves that fat into acids and a solution of glycerine, which are carried over mechanically by the steam. I know that the
642 acids were not subjected to a distilling heat; I therefore infer that when Scharling says the acids distilled over, he means the water was distilled, carrying the acids and glycerine with it.

X X Q. 158. Do you mean that the fat acids and glycerine were in a state of vapor, mixed with the vapor of water, and were carried over with it?

A. I do not so mean; neither do I so believe. Scharling states that he was induced to make the experiment by the use made in England of superheated steam for the bleaching of palm-oil. In that process I understand the palm-oil was bleached and decomposed by the action of the superheated steam, without any distillation thereof.

X X Q. 159. In Scharling's experiment with two pounds of palm-oil, described in Exhibit 12, where do you understand that the one pound of fat acid, stated to be produced, was found?

A. It was found carried over by the steam after it was condensed into water.

X X Q. 160. This pound of fat acid was found in the condenser, was it?

A. No doubt it was.

X X Q. 161. In what state—solid, liquid, or vapor—did it pass out of the copper boiler into the condenser?

A. Undoubtedly in a liquid state. Scharling states that palm-oil, castor-oil, and tallow "are decomposed by the superheated vapor of water alone, in a similar manner as by the strong bases."

X X Q. 162. Do you understand, from Exhibit 12, that Scharling states that the fat acids were distilled over?

A. I do understand he so stated, but at a heat that will not decompose fat; that, as fats will not distill without decomposition, I infer from his statement and from my experiments that he did not so mean.

X X Q. 163. In your opinion, is Scharling's statement—that in his experiments the fat acids were distilled over—correct or incorrect?

A. In one sense it is correct, because the fat was decomposed by the vapor of water, and the products of decomposition were carried over by it. It is incorrect by leaving the inference that a decomposing heat was used. The object of Scharling was to show that fats could
643 be dissolved, without a decomposing heat, into fat acids and solution of glycerine. Eight years previously to the publication of his experiment Dubrunfaut had announced as follows: "Upon submitting palm-oil, at the temperature of ebullition, to a current of divided vapor of water, there is a distillation of the developed fatty acid." This was a destructive decomposition, because the temperature used was that which would itself decompose fats into other products than fat acids and solution of glycerine. Scharling claimed to show that, by his method, the fats were dissolved without destructive decomposition.

X X Q. 164. I understand you then to say that, taking the heat used by Scharling to have been 160° C. or 320° F., his statement, that at

that heat the fat acids were distilled over, is incorrect. Is that your opinion?

A. As that temperature is not the temperature of ebullition of palm-oil, I cannot suppose that he intended to state that it was distilled, but, as before stated, that it was dissolved and carried over mechanically by the steam.

X X Q. 165. The former question, No. 164, repeated.

A. I can give no fuller answer than I have given in the next preceding and previous answers.

X X Q. 166. In Scharling's experiment, in Exhibit 12, do you understand that there was any liquid water present, mixed with the fat in the boiler, heated to 320° F.?

A. Scharling does not state whether he commenced his experiment by heating the boiler before the introduction of the superheated steam. He states that the palm-oil, by means of the steam passing through it, "attained a temperature of about 160° C." The boiler was kept at the same temperature by means of a coal fire, consequently, I cannot state whether there was any water in the boiler or not. If steam was applied to the fat before it was heated it would condense and form water; if the steam was applied after the boiler was heated no water would form.

X X Q. 167. I understand you then to say that during the time that the fat in the boiler was heated to 160° C. or 320° F., and the production of fat acid was going on, no liquid water was present, mixed with the fat. Is that your opinion?

A. That is my opinion.

X X Q. 168. Was any high pressure applied to the boiler?

644 A. I suppose there was no pressure. The fat was changed, as Scharling states, in the same manner as by the strong bases.

X X Q. 169. Do you understand that the defendants' processes, as described in their answers, the free fat acids are produced in the same manner as in Scharling's process?

A. If you mean by "manner," to inquire whether the chemical processes are the same, I should say that they were.

X X Q. 170. You have stated, in answer to Questions 159 and 160, that in Scharling's process the fat acids produced were covered over by the steam and found in the condenser. Do you understand that this takes place also in defendants' processes?

A. Certainly not. If a neutral fat is submitted to the action of boiling water it will be dissolved into fat acids and glycerine. It is not necessary that any steam or pressure should be used. It has also been shown that the same results will be produced by water at the temperature and pressure of the atmosphere. A high heat and pressure only facilitates the decomposition, which complainant claimed to effect in ten minutes by his patented process, that being the maximum time.

X X Q. 171. If no steam was introduced into defendants' digester, and the materials therein were thoroughly mixed by mechanical stirrers, and were heated by an outside steam-jacket to the same temperature and pressure as he now uses, would there be any difference in the products obtained from what he now obtains; and if so, what?

A. I infer not.

Second re-direct:

Q. 172. Calling your attention to re-cross-question 163 and the answer thereto, I understand you to use the word "decompose" therein in the sense of destructive decomposition or a decomposition that would destroy the glycerine of the fat. Am I correct?

A. That is the sense in which I used it.

Q. 173. Taking the word "decomposition" to mean the separation of neutral fats into free fat acids and glycerine, I understand you to state, as your belief, that Scharling obtained, by steam decomposition, both of those products. Am I correct?

645 A. I do not state it as a matter of belief only, but as positive knowledge. I have tried the experiment.

Q. 174. I further understand you, in your cross-examination, as to the meaning of the words, "the acids distilled over," used in Exhibit 12, (Scharling,) to mean that said acids were not distilled in the sense of being converted into vapor, but that they were dissolved by the steam in the boiler, and carried over in liquid form by the steam into the condenser. Am I correct?

A. That is my opinion, based upon the exhibit and my experiments made in conformity therewith.

Q. 175. Is it your opinion that, because in the defendants' process the products are not carried into a condenser, as used by Scharling, that the decomposing or dissolving power of the steam employed by defendants is in any manner affected?

A. Fats cannot be dissolved into acids and glycerine without moisture. Whether that moisture is communicated to them in a liquid form, or in the form of vapor, makes no difference; the effects of both are chemical and identical at the same temperature; consequently I infer that the steam used by defendants is as effective at the same heat as it would be if used in an open vessel or still.

R. G. MITCHELL.

Sworn to before me on this 20th day of May, 1869, and subscribed to before me on the 29th day of May, 1869.

CHARLES H. KITCHEL,
Notary Public in and for the City and County of New York.

FLORENCE VERDIN, being first duly cautioned and solemnly sworn, in answer to questions propounded to him by Charles B. Collier, esq., counsel for defendants, deposes and says as follows:

Question 1. Please state where you reside, and what is now your occupation.

Answer. I reside in Rockland County, New York State; my occupation is farming.

646 Q. 2. Have you been engaged at any time in the manufacture of fat acids and glycerine; if so, when and where?

A. I have been engaged in the manufacture of tallow candles from 1840 to 1842, and from 1842 I have been engaged in the manufacture of fatty acids and glycerine up to 1868, partly in Cincinnati, and eighteen years in New York.

Q. 3. Have you read the letters-patent granted to Richard A. Tilghman, the complainant herein, dated October 3d, 1854, and do you understand the same?

A. I have read it, and believe that I understand it.

Q. 4. What do you understand to be the improvement claimed in said letters patent?

A. I believe the improvement in this patent is the shortening of the time in the decomposition of neutral fats, if it could be practically worked.

Q. 5. Have you made any experiments to ascertain whether the improvement described and claimed in said letters-patent can be practi-

cal'y worked? If so, state fully what experiments you have made, when and where they were made, how they were made, and what was the result of the same.

A. I have tried—first, in a small vessel, six inches deep, half-inch bore, with a valve at the end of it, kept down with a screw at the top, so that it would resist the pressure required. I filled the vessel one-third with water and two-thirds with fat, and immersed it in a potful of melted lead, and kept it immersed for ten minutes; afterwards I cooled it down rapidly, and by the opening I found fatty acids, with glycerine and acroleine. I have made several more experiments in the same manner, and the results were the same. I made these experiments at R. G. Mitchell & Co.'s factory about four years ago; I think in 1864.

Q. 6. Was the fatty-acid product obtained by said experiments a suitable material for the manufacture of candles; if not, why not?

A. It was not. It was dark and tainted with acroleine, which is a great objection to the candles.

Q. 7. What was the quality of the glycerine obtained in said experiments?

A. The quality of the glycerine obtained was very poor, what there was of it, and could not be used for any purpose.

647 Q. 8. Do you understand the construction of the tube or coil apparatus described in said patent?

A. I do understand it.

Q. 9. Have you made any experiments to test the practical working of the complainant's patented improvement in the said tube or coil apparatus; if so, when did you make such experiments, and where? Describe the apparatus in which you conducted said experiments, and state the results thereof.

A. I have made an apparatus which was constructed according to the complainant's specification in his letters-patent, only in a smaller proportion. The pipe was thirty-six feet long, half an inch diameter inside, and the outside one inch diameter. It was coiled in oblong coils, one inside the other, and one-quarter of an inch space between them, and then filled up with cast iron between the coils, and the outside was covered with a quarter of an inch of cast iron, and so likewise was the inner side of the coil. This was set in a brick furnace. The upper part of the fire was twelve inches from the lower part of the coil apparatus. On one end of the coil apparatus, made of the same strength as the pipe, and of the same size, was a condenser, which was bent in the shape of a worm-pipe, the same as distillers generally use. On the outer end there was an exhaust-valve, loaded with 2,400 pounds to the square inch. The outer end had a hydraulic force-pump, by which the water and fat were injected through the coil apparatus. There were four iron tubes in the upper end of the coil apparatus, going from the top over into the side of the coil apparatus, which were put there for the purpose of testing the heat by the melting-point of the different metals used. The metals used were tin, bismuth, lead, and saltpetre. We commenced at the melting-point of tin, and went upward to the melting-point of lead. At the melting-point of tin I observed small traces of acroleine, and the higher the heat increased the stronger the smell of acroleine increased. At the melting-point of bismuth I perceived it freely, and before I got it up to the melting-point of lead the acroleine was very strong. I never had it at the melting-point of saltpetre. When the acroleine was not strong at the melting-point between tin and bismuth, the fat was only partially decomposed. The charge was composed of two

648 pints of fat with one pint of water. This was put in a vessel

made in the shape of an ordinary butter-churn; the disc was perforated with one-eighteenth inch holes, and was worked up and down while the operation continued, in order to make an emulsion of the fat and water. The hydraulic pump used was half inch in diameter, and of three inches stroke, and fourteen strokes a minute. I filled the tube with water in the first place, and the wate' was heated to the melting-point of tin. After it had reached that temperature, we commenced forcing the fat and water through the coil apparatus, so that it took ten minutes to pass through the coil from one end to the other. Then the heat was gradually increased to the melting-point of lead, and kept at that point as near as possible, and so we continued that operation for three or four hours. We worked the pump regularly; I was counting the strokes, and the result was that the glycerine was always decomposed and acroleine formed; that is, most of the glycerine was so decomposed, and that which remained was worthless, and the fatty acids were not thoroughly decomposed, i. e., at the melting-point of tin; and the action was so irregular that the discharge would be sometimes too fast, as the valve opened, and the supply was not in proportion. The irregular action is caused by the great pressure on the valve when the valve opens once. It does not shut fast enough, and that caused the discharge to be greater than the supply, and leaves steam-room in the pipe. This coil apparatus is now at R. G. Mitchell & Co.'s factory in New York City. I repeated the same experiment with the same apparatus, and with the same results, at Cincinnati, in the presence of M. Werk, George Shillito, and Charles T. Jones, and others, in April, 1867.

Q. 10. Could, in your opinion, the said coil apparatus be so worked as that the charge forced into it by the pump would always be the same in quantity as that forced out by the pressure at the exit-valve, so as to keep the apparatus always full of the mixture and prevent any steam forming in the coil?

A. It could not. Steam will form in the coil. The overheated water inside of the coil, when it gets vent, will almost act like the explosion of gunpowder, and will not give the valve a chance to shut immediately.

Q. 11. In the complainant's patent it is stated as follows: "But
649 when the pump forces fresh mixture into one end (j) of the heating tubes, (d, d, d,) the exit-valve (i) is thereby forced open to allow an equal amount of the mixture, which has been operated upon, to escape out of the cooling tubes (h, h,) at the other end of the apparatus." In your opinion as a manufacturer, and from your experiments with said coil apparatus, are you able to say whether an equal amount of the mixture will be forced out at the exit-valve as is forced in by the pump?

A. I do not believe that the valve could be so regulated as to exhaust an equal quantity as the pump will force into the coil. I have endeavored to do my best to produce a regular discharge, and could never accomplish it.

Q. 12. How, if at all, could the operative, if the pump was worked by hand, know whether an equal amount of the mixture was passing out of the exit-valve as was being forced in by the pump?

A. He could not know at all, as there is no indication in the specification in the patent to measure the quantity exhausted.

Q. 13. In the said patent it is stated as follows: "No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture. For this purpose, whenever it may be required, the speed of the pump should be increased so that the current through the tubes may be made sufficiently rapid to carry out with it

any air remaining in them." Will you state your opinion as to the practicability of so increasing or regulating the speed of the pump, so as to keep the tubes entirely full of the mixture, and to prevent at all times the presence of steam or air therein?

A. If the tube has to be kept full by quickening the motion of the force-pump, the fat will never be subjected to the heat long enough to decompose thoroughly, as the increased motion of the pump will carry the fat faster to the exhaust-pipe than the time specified, and therefore it will only partially be decomposed.

Q. 14. How would the operator working the pump know when to increase and when to decrease its speed, so as to produce a constant and regular discharge?

A. There is no means of knowing; there is nothing in the patent to show or to measure the quantity exhausted.

650 Q. 15. The patent says: "From the exit end (*g*) of the heating tubes (*d d*) the mixture which has then become converted into free fat acids and solution of glycerine passes on through another coil iron tube (*h h h*) immersed in water, by which it is cooled down from its high temperature to below 212° F., after which it makes its escape through the exit-valve (*i*) into the receiving vessel." Could the operator of the pump, from observation of the flow after the passage of the material through the condenser, so regulate the speed of the pump as to keep the heating-tubes constantly full of the heating mixture, n your opinion?

A. He could not.

Adjourned until the 27th, at the same place, 9½ o'clock in the morning.

THURSDAY, *May 27th*, 9½ *a. m.*

Examination of F. Verdin continued:

Present, Mr. Collier, for defendants, and B. C. Tilghman, for complainant, R. A. Tilghman.

Q. 16. What would be the effect as to the presence or absence of steam in the tubes if the exit-valve leaked?

A. There would be a formation of steam.

Q. 17. How far, in your opinion, would it be possible to prevent, at the temperatures and pressures contemplated by the patent, the leaking of steam by the exit-valve?

A. I don't know of any mode of preventing the leaking of steam at the exit-valve, unless it is regulated with another machine connected with the exit-valve in connection with an hydraulic force-pump, so that by the same motion of the force-pump opens and shuts the exit-valve.

Q. 18. In the experiment first testified to by you, in which you used a small vessel filled with one-third part water and two-thirds fat, immersed in a bath of melted lead, you have stated that acroleine was produced; will you now state whether the same result would be produced at the same temperature in the coil apparatus, even if it was kept full of the mixture, as was the case with the closed vessel used by you, as testified to?

651 A. I think that in the small tube which was exposed in the lead bath at the heat of the melting-point of lead is rather darker than the one which was produced by the coil apparatus; but, as to the amount of acroleine, I think they were both alike.

Q. 19. Did you make any other experiments with the small closed vessel than the one you have described? If so, describe such other experiments, and state what were the results thereof.

A. I have made such. The first was partly filled with fat and water, about one-third empty, and exposed at the melting-point of lead. It was treated exactly like the first experiment, and the result was the same. I kept it turning over and over in the lead. I made another experiment in five minutes, and filled the vessel full—one-third of water and two-thirds of fat—and kept it five minutes in the lead bath. The result was, I had strong acroleine, and the fat was not thoroughly decomposed. It was not fit for candles, and showed the acid strong on the litmus paper. And I made three more experiments. I bored two holes in the same vessel, one for tin and the other for lead. I filled the vessel the same as for the previous experiment, and exposed it to a charcoal fire, and kept it in that position until the tin was melted. I watched it closely, so as to notice that the lead in the other hole should not come above the melting-point. The result was very bad. I had scarcely any glycerine left. The glycerine was almost all decomposed, and the fat acids tasted very strongly of acroleine. The next experiment I made was with the melting-point of tin alone over the same fire, in the same manner, and the result was the fatty acids were black; they were not quite so black as at the temperature of melting lead, and not as much acroleine. The third operation I have made was put in a pot of melted lead, and the experiment was tried in the same way as the experiment first mentioned, and the result was the same as in the first operation.

Q. 20. What is your opinion as to the practicability of the complainant's process, at the temperatures and pressures named in the patent, in any "convenient vessel," supposing such vessel to be of the form commonly known as a Papin's digester, and with a charge of fat of the quantity ordinarily used by manufacturers?

652 A. My opinion is that there can no vessel be made strong enough to resist the heat and pressure described in the complainant's patent.

Q. 21. Do you know of any means, mechanical or other, by which, in such vessel or digester, the mixture of fat and water could be so agitated as to produce a decomposition of the entire fat in the time mentioned in the patent for the decomposition to take place?

A. I do not know of any means to produce a mechanical mixture and at such high temperature and pressure as described in the complainant's patent.

Q. 22. Suppose the operation to be conducted in a Papin's digester, with agitation, at the temperatures named, viz, either of melting lead, bismuth, or tin, what, in your opinion, would be the effect of such heat upon the glycerine resulting from the first decomposed fat, when all the fat in the digester would be decomposed?

A. My opinion is that most of the glycerine would be decomposed into acroleine.

Q. 23. And how would it affect that portion of the glycerine that was not itself decomposed into acroleine?

A. The glycerine that was not decomposed entirely into acroleine could not be sold in this market.

Q. 24. And how would the fatty acids be affected by the acroleine?

A. The fatty acids would always have a smell of acroleine, and the candles from the stearic acid would not be a salable article as if they were without the smell of acroleine, and the oleic acid would sell from eight to ten cents a gallon less than if it was not tainted with the acroleine.

Q. 25. Have you made an experiment at the manufactory of C. T.

Jones, for the Ohio candle-works in Cincinnati, to acidify fat by water in a close vessel on a manufacturing scale; if so, describe such operation?

A. I have made an operation at the Ohio candle-works. I filled their boiler in the same way they were accustomed to work it, with two-thirds of fat and one of water; we ejected the steam at the pressure of 180 pounds to the square inch; and the reason why I went to
653 Cincinnati and had these experiments made is, I wanted to know how long it would take, by heat, pressure, and water alone, to decompose tallow into fatty acids and glycerine, at the heat used in Wright & Fouché's apparatus, say about a heat 374° F., or 180 pounds pressure to the square inch. After keeping it under the pressure of twelve atmospheres, or 180 pounds pressure to the square inch, or at 374° F., for thirty-six hours, I found that less than three-fourths of the fat was acidified. I had the glycerine water tested: it had not quite three degrees Beaumé. After the thirty-six hours' operation we did let the glycerine water settle from seven o'clock in the evening until seven o'clock the next morning. The water was drawn off clear from under the fat, and a fresh charge of water was injected, and steam was used at 250 pounds pressure to the square inch. The pump was put in operation to produce the circulation of water through the fat for about three and a half hours. This completed the operation. After testing the glycerine water I found it had a little over one degree Beaumé. This convinced me that it would take more than fifty hours to complete the operation, at the pressure of 180 pounds to the square inch, and at a heat corresponding to the pressure without a circulation.

Q. 26. How many pounds of fat was used in said experiment?

A. I do not remember. I think it must have been about four or five thousand pounds.

Q. 27. What is the amount of fat treated in the Wright & Fouché apparatus, at each operation, at the establishment of R. G. Mitchell & Co.?

A. They have six machines at the works of R. G. Mitchell & Co. Each machine contains about 1,100 pounds; say about 7,000 pounds for all six of them.

Q. 28. What time is occupied in effecting the decomposition in said machines?

A. It takes from eight to ten hours, after the machine is under pressure. It takes about three hours to get it under pressure; two hours and a half to let it run down and empty. We can fill it in half an hour. Each machine is separate; the circulation is independent.

Q. 29. What price is obtained for the solution of glycerine by R. G. Mitchell & Co.?

A. R. G. Mitchell & Co. do not sell their solution of glycerine;
654 they bring it into market concentrated at 28° Beaumé, and I believe they sell that at thirteen cents per pound.

Q. 30. About what quantity of glycerine, of the strength named—28° Beaumé—is obtained by them from a barrel of forty gallons of the watery solution—4° Beaumé?

A. I do not recollect.

Q. 31. What would be the value in the market of a barrel of the watery solution of 4° Beaumé?

A. I do not know what it would bring.

Q. 32. What provisions, if any, do you, as a manufacturer, find for circulation in the complainant's patent, in the practice of his process in "any convenient vessel," referred to in said patent?

A. I cannot find any provision in complainant's patent. He says: "My invention consists of a process for producing free fat acids and a solution of glycerine from those fat and oily bodies, of animal and vegetable origin, which contain glycerine as their base. For this purpose I subject these fatty or oily bodies to the action of water at a high pressure and temperature, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine. I mix the fatty body to be operated upon with from one-third to one-half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting-point of lead, until the operation is completed. The vessel must be closed, and of great strength, so that the requisite amount of pressure can be applied to prevent the conversion of water into steam."

Q. 33. Which of the fatty bodies commonly employed in the manufacture of fatty acids into glycerine is most easily decomposed?

A. Palm-oil; next to it is lard and marrow; and tallow is the hardest to decompose.

Q. 34. Are you, or have you been, a partner of R. G. Mitchell?

A. I have been a partner of R. G. Mitchell; am not now.

Q. 35. Have you read, and do you understand, the Defendants' Exhibit No. 21, being description of Wilson's process, as contained in Campbell Morfit's Chemistry Applied to the Manufacture of Soap and Candles, published in Philadelphia, 1847, page 340, and do you understand the drawing shown in said exhibit? (Agreed printed copy of said exhibit is herewith produced and hereto annexed, marked Exhibit No. 1, Verdin, May 27th, 1869.)

655

A. I have read it, and I have worked the apparatus.

Q. 36. From your experience as a manufacturer are you able to state, and if so, will you state, the result of the process, as described in said exhibit, as to the production of fatty acids and glycerine, in case either crude or commercial lard or tallow was submitted thereto?

A. If crude tallow or lard is subjected to Wilson's process, and kept under pressure from "ten to fifteen hours" at a pressure of fifty pounds to the square inch, some of the melted fat will be partially decomposed, producing fatty acids, and, undoubtedly, glycerine.

Q. 37. On what do you base the opinion which you have just expressed?

A. I base the opinion on my practical knowledge of the working of the process, which I have worked for several years, from 1842 to 1845. When I commenced the process of rendering the fat in the tanks at M. Werk & Co.'s candle-works in Cincinnati, I found, by exposing the fat too long a time under pressure, that it partly decomposed; i. e., at a pressure of sixty pounds to the square inch, and from ten to twelve, and sometimes fifteen hours.

Q. 38. Have you read, and do you understand, Defendants' Exhibit No. 1, title—"Fat changed in Perkins' engine;" if yea, what, in your opinion as a practical manufacturer, was the nature of the change produced in said fat?

A. I have read it and understand it. In my opinion, it was fatty acids combined with the impurities of the water used and the metals dissolved by the acids.

Q. 39. If you had seen said exhibit prior to 1854, what inference would you have drawn from it, do you think?

A. The inference I would have drawn from it would have been that fats could be decomposed into fatty acids and glycerine by heat, pressure and water at a high temperature; and had I had that in

656 1843 or 1844, when I made my first experiment to decompose fats with water and pressure, I think I would have succeeded in the decomposition of fats by water and pressure at that time.

Q. 40. What experiments did you make in 1843 and 1844?

A. I subjected water and fat, at a pressure of about sixty pounds to the square inch, in a close vessel two feet by eighteen inches diameter. I kept it under pressure for about twenty-four hours, and the result was bad; it was not decomposed.

Q. 41. Was any portion of the fat decomposed?

A. I had no knowledge of it then.

Q. 42. What provision in said experiment, if any, did you make for circulation?

A. I had no provision made whatever for the circulation. I had a spiral closed steam-coil going through the apparatus, which came out from the lower part of the vessel; therefore I used nothing but the heat of the steam-pipe to give heat to the material in the vessel.

Q. 43. What led you to try this experiment?

A. M. Werk requested me to get the machine made, as he had heard that fats could be decomposed at a high heat and pressure, and therefore I tried that experiment.

Q. 44. Did you communicate to any one, if so, to whom, the fact which you have stated you had observed of the partial decomposition of the fats which you rendered, in 1843, 1844 and 1845, in Wilson's apparatus?

A. I did; I believe I told it to M. Werk, and to my brother, Nicholas Verdin, and to one by the name of Lang, who was at that time a partner of the firm of M. Werk & Co., of Cincinnati.

Q. 45. About how much fat did you treat by the Wilson process during the years you have mentioned, and what did you do with the products of such process?

A. I suppose I averaged about 2,500 to 3,000 pounds a day during the year; and M. Werk converted it into tallow candles, and used some of it in the manufacture of fatty acids and glycerine.

Q. 46. Did you observe whether that portion of it which was converted into "tallow candles" was strictly neutral tallow, or partly acidified tallow; if so, what was the result of your observation?

657 A. It was not strictly neutral tallow. It was partly decomposed or acidified, and the best proof I had of it was shown by the oxidation of the lead in the pewter candle-moulds, into which it was run for making tallow candles.

Q. 47. When you tried the experiment described in answer to question 40, did you submit the product, after treatment, to any chemical tests to ascertain if the fat had been partly acidified?

A. I made no test of it.

Cross-examined by B. C. Tilghman, esq.

X Q. 48. Have you a pecuniary interest against the validity of the patent sued on herein?

A. I have an interest against the patent, but not in this particular suit.

X Q. 49. If, in the suit of Tilghman against Mitchell, a sum of money is decreed to be paid to the complainant, what proportion of that sum will you be responsible for?

A. I suppose one-half of it.

X Q. 50. All your experiments with the coil apparatus were made after the commencement of the suit of Tilghman against Mitchell, and after you were acquainted with the testimony of Professors Booth,

Rogers, and Bridges, as to the working of the coil apparatus in Philadelphia, were they not?

A. They were.

X Q. 51. In your experiments with the coil apparatus, what was the nature of the material which came out at the exit-valve; was it clear fat and clear water, distinct from each other, or was it a mixture or emulsion of fat and water?

A. It was a clear fat and water. The moment it came out the water separated from the fat. It looked milky as it came out of the exhaust-valve, but separated immediately, and the water became clear. I supposed it was mixed when it came out, but separated immediately after.

X Q. 52. Was the rate of discharge from the exit-valve more regular when the coil was at the heat of melting ten or bismuth than when it was at the heat of melting lead?

A. It was more regular at the melting-point of tin.

X Q. 53. The explosive discharges you have spoken of occurred at the melting-point of lead, did they not?

658 A. They occurred between the melting-point of bismuth and lead.

X Q. 54. What was the reason of this difference, do you suppose?

A. I suppose by putting a much heavier weight on the lever of the valve it might prevent these explosions.

X Q. 55. In these explosions a large quantity of the mixture was thrown out at one time, was it not?

A. It was.

X Q. 56. And the tubes were then partly empty of the mixture, and consequently so far filled with steam, were they not?

A. I suppose they were.

X Q. 57. In your experiments, was the same weight used on the exit-valve at all the temperatures, from melting tin to melting lead?

A. The same weight was used at all the melting-points.

X Q. 58. Have you any direct personal knowledge of the amount of pressure produced in the tube by the weight used on the lever of the exit-valve?

A. I had not. I left that to the mechanic who built the machine. The weight was twenty-three pounds. Mr. Tilghman himself went up to the works and measured the fulcrum of the lever, and if anything had been wrong I suppose he would have told me. I do not recollect the length of the long and short arms of the lever.

X Q. 59. When the patent states that the "decomposing power of the water becomes more powerful as the heat is increased," did you not infer from this that the decomposing power of the water became less powerful as the heat is diminished?

A. I did; but that does not make any material difference upon the pressure upon the materials in the pipes. I mean that the weight on the valve has nothing to do with the heat. There can be 2,000 pounds pressure to the square inch at the melting-point of tin, which is produced partially by the heat at the melting-point of tin and the other part by the pressure of the hydraulic pump.

X Q. 60. Did you not understand from the patent that at the temperature of melting tin a longer time would be required to produce decomposition than at the melting-point of lead?

659 A. I did understand that. The time is not mentioned in the patent. It only speaks of ten minutes.

X Q. 61. In your experiments, the rate of working of the pump was

the same at all the temperatures used, from melting tin to melting lead, was it?

A. It was always the same—so that it should take ten minutes to go through the coil. My aim was to complete the operation in ten minutes, as prescribed by the patent.

X Q. 62. Had you the chief direction and managment of all the experiments with the coil apparatus made in New York and Cincinnati?

A. I had here in New York, to a certain extent, and my nephew, who is now deceased, to the other extent; and in Cincinnati I did not want to have anything to do with it whatever. I wanted the manufacturers of Cincinnati to operate with it themselves, so that they could judge for themselves the value of the process. I also, at their request, took the chief management of it in Cincinnati.

X Q. 63. In your experiments with the coil apparatus, what proportion of all the glycerine produced was converted into acroleine?

A. I suppose about nine-tenths of it was converted into acroleine.

X Q. 64. How did you ascertain this fact?

A. I ascertained it by the taste of my tongue, that there was about that amount of decomposed glycerine; and the remainder of the glycerine, after it stood over night, it could not be found the next morning; there was not the slightest taste of glycerine then.

X Q. 65. How many degrees of Beaumé did the glycerine liquor show by the hydrometer when cold?

A. I did not test it by the hydrometer, and the quantity was so small that it could not be shown by the hydrometer.

X Q. 66. In commerce is not the strength of glycerine water estimated by the hydrometer?

A. It is; but if you were to bring that glycerine in the market and have it tested they would pronounce it water.

X Q. 67. Referring to your answers to questions 11 and 12 in-
660 chief, suppose that, in working the coil apparatus, you knew that the pump was forcing in regularly one pint per minute of mixture, and you found by measure that the discharge from the exit-valve was also regularly one pint per minute, could you not infer that the directions of the patent were complied with, to allow the amount of mixture forced out to be only equal to that forced in?

A. I could not measure it, because the discharges are sometimes so rapid that a man would run the risk of getting blind by attempting it.

X Q. 68. Have you ever seen the fat acids produced by the action of concentrated sulphuric acid on fats previous to their distillation?

A. I have.

X Q. 69. Was the fat acid produced in your experiments with the coil apparatus darker or lighter in color than fat acids acidified by sulphuric acid?

A. It was a great deal lighter.

X Q. 70. In your opinion, could not the fat acids produced in your said experiments have been purified by distillation, in the same way as the darker fat acid acidified by sulphuric acid?

A. They could be purified by distillation, but it adds to the expense; for instead of one process you have two.

X Q. 71. Would not distillation remove the smell as well as the color?

A. I do not think it would entirely, as there is always with the distilled fatty acids a peculiar kind of smell, and that I presume results from the acroleine.

X Q. 72. You mean that it would probably have the same smell as the distilled products of the sulphuric-acid process, do you not?

A. The same as I smelled it in the Ohio candle works.

X Q. 73. The distilled products in the sulphuric acid process are largely manufactured and sold in commerce, are they not?

A. They are.

X Q. 74. In your opinion, is not the proper regulation of the exit-valve the most important feature of the working of the coil apparatus?

A. I suppose it is, if it can be done; and I wish that some one would show me how to do it.

661 X Q. 75. When did you first see neutral fat decomposed into fat acids and a solution of glycerine by the action of water at a high temperature and pressure, knowing at the time that such a decomposition had been effected?

A. I first saw it in 1859 or 1860, when Wright & Fouché sold their patent to R. G. Mitchell & Co.

X Q. 76. Down to that time, what agency had you employed to effect this decomposition of neutral fats?

A. I had employed lime, from twelve to fourteen pounds to one hundred pounds of fat, and sulphuric acid in proportion.

X Q. 77. Why did you not, during all the time of your manufacturing prior to 1859, dispense with the use of lime and sulphuric acid, and substitute the use of highly-heated water under pressure?

A. Because I could not find a process better than the lime process, until Wright & Fouché introduced their process by the circulation of the water.

X Q. 78. What is the use of circulation?

A. The use of circulation is to keep the water always in contact with the fat.

X Q. 79. Provided the water is kept in contact with the fat, does it make any difference how that contact is produced?

A. I do not suppose it does.

X Q. 80. In the old lime saponification process, was not contact of the fat, water, and lime produced by the injection of steam and by mechanical stirring?

A. I never have used stirring when I first added the lime; the steam was then sufficient to keep it in motion; and after it got thick and began to solidify, we had to stir it to keep it apart so as not to form a solid mass.

X Q. 81. In the old process, then, steam was used to mix, agitate, and produce contact of the lime, water, and fat, was it not?

A. Steam was used to heat and bring the water, lime, and fat into contact with each other.

X Q. 82. Do you understand, from complainant's patent, that it is intended that the fat and water should be kept mixed together during the operation?

A. It is so expressed in the patent.

662 X Q. 83. Referring to the Defendants' Exhibit No. 21, (Wilson's tank,) is the fat produced by Wilson's tank process commonly known and used in commerce and manufactures as a neutral fat, or as a fat acid?

A. It was always considered and used as a neutral fat, but it never was thoroughly neutral. Even after it had been tried out over the naked fire, it always turned rancid a great deal sooner than the tallow or lard which had been rendered in the ordinary mode—in the kettle over the fire without steam.

X Q. 84. At the present day, is it not still considered and used as a neutral fat in commerce?

A. It is so used; but I have always avoided using it, and the tallow chandlers have abandoned the process of rendering by steam, and use the old method of rendering tallow; and the kettle-rendered tallow will always bring from one-quarter to a half cent more per pound than the steam rendered.

X Q. 85. The quantity of fat acids (if any) existing in Wilson's tank product was then an injury to its value, was it not?

A. It was.

X Q. 86. Do you know positively what percentage of fat acids exist in Wilson's tank product?

A. I do not know. The only reason why I know that a fat acid is present is, in saponifying steam-rendered tallow, the saponification of the tallow goes on a great deal quicker than with the tallow which was rendered by the old mode. It takes only two hours to produce a lime-soap, while with the kettle-rendered tallow it takes four hours before the lime-soap becomes solid. This shows an indication that there must be considerable fatty acid present. The slower saponification always produced the best fatty acids.

X Q. 87. Do not rancid fats generally saponify quicker than fresh ones?

A. They do. This shows that there is some decomposed fat in the rancid fats; for instance, if we take decomposed fat and boil it, and add lime to it, it becomes a lime-soap almost instantly.

X Q. 88. Did you ever see or know of any glycerine obtained from the watery product of Wilson's tank process?

A. I have not; and I believe it would be very difficult to de-
663 tect the small proportions of glycerine produced by that process, as there is always too much glutinous and fibrous matter combined with the water.

X Q. 89. Can you swear, of your own personal knowledge, that there exists in the ordinary commercial fatty product of Wilson's tank process as much as one per cent. of free fatty acids?

A. I cannot, as I have never tested it.

X Q. 90. In your answer to question in-chief No. 38, you stated that it is your opinion that the "fat changed in Perkins' engine was fatty acids combined with the impurities of the water and the metals dissolved by the acids." Do you mean thereby that said product was a soap of lime and the metals, or do you mean that it was a free fat acid?

A. I mean that the product from Perkins' engine was partially a soap made by the impurities of the water combined with the metals from the engine and part of it was free fatty acids.

X Q. 91. What proof have you in that exhibit that part of said product was free fatty acids?

A. The proof that I have is, that a part of it was dissolved by alcohol. Alcohol is proved, since the discovery of fat acids by Chevreul, to be a test for fatty acids, if there be any present.

X Q. 92. Have you any other proofs? If so name them all.

A. I have. There is litmus paper, and I believe there is ether; but some of the chemists, as I have heard, hold that pure ether does not dissolve fatty acids.

X Q. 93. Name all the proofs you find in said exhibit—that a part of the changed fat was free fatty acids.

A. The alcohol is one proof, and the solubility in the alkalies is another proof.

X Q. 94. Exhibit 1 states that the black, dirty scum was digested in hot alchol, and the clear solution set aside. In your opinion, did this

clear solution contain only the free fat acid portion of the scum, or did it contain also the lime and metallic soap portion thereof?

A. It must have contained some of the lime and metallic soap, or the fatty acids would have come out of the usual color of fatty acids.

664 X Q. 95. Then lime and metallic soaps are soluble in hot alcohol, as well as free fat acids: is that so?

A. I know lime-soap is not soluble in hot alcohol; as for metallic soap, I have never tested it, and do not know.

X Q. 96. Then you know that the clear, hot alcoholic solution contained no lime-soap; is that so?

A. It may have contained some lime-soap, but the lime-soap was perhaps not in the same condition as that which I have tested.

X Q. 97. At this moment do you know whether lime-soap is soluble in hot alcohol or not?

A. I have always understood that it was not.

X Q. 98. And your present belief is that lime-soap is not soluble in hot alcohol; is that your belief?

A. That is my belief; and if it is soluble, it is so only to a small extent.

X Q. 99. Exhibit I says that the hot alcoholic solution from the black scum, when cool, let fall flocculi in abundance, which, when collected and fused, gave a "grayish substance." In your opinion, what was the chemical nature of this "grayish substance," judging from all that is said of it in the exhibit?

A. In my opinion it was still a mixture of the fatty acids and impurities of the water.

X Q. 100. What do you understand from the exhibit to have been the properties of the "grayish substance"? Name all that are described.

A. I understand it contracted and cracked as it cooled, and had the lustre and appearance of wax, but was rather more brittle. It did not melt in boiling water, but did at a higher heat, and ultimately it burned like fat. It was rather lighter than water, and dissolved readily in alkalies—more readily, the author thinks, than fat, and in that respect the author thinks it resembles Chevreul's acids of fat, as well as in its solubility in alcohol. The alkaline solution was turbid. It was not soluble in ether, or very slightly so; when burnt, it left an ash consisting principally of carbonate of lime.

X Q. 101. Is it your opinion that the "grayish substance" contained some lime-soap mixed with some free fatty acids?

A. That is my opinion.

665 X Q. 102. As the "grayish substance" is described as being soluble in alcohol, then lime soap, as well as free fat acid, must be soluble in alcohol, must it not?

A. I said once before that that lime-soap may have been in a different condition from the one I have tested. In a chemical composition the slightest presence of another substance changes the whole composition.

X Q. 103. As the "grayish substance" is described as being soluble in alcohol, then that particular kind or condition of lime-soap existing in it, as well as the fat acid existing in it, must both have been soluble in alcohol, must they not?

A. The one particular kind of substance may have the power to make the other substance soluble in alcohol, and with this explanation they both were soluble in alcohol.

X Q. 104. In that case, then, was solubility in alcohol a reliable test—that the matter dissolved was free fat acid?

A. I believe it was; and they (the fatty acids) were only combined mechanically with the carbonate of lime.

X Q. 105. Then, if the fatty acid was only combined mechanically with the carbonate of lime, there was really no lime-soap present at all, was there?

A. I suppose there was not. It is not always the case when you find carbonate of lime that neutral lime-soap has been present.

X Q. 106. Then, if no lime-soap was present, but only mechanically-mixed carbonate of lime, how did the carbonate of lime exist in the clear, hot alcoholic solution from which this "grayish substance" was obtained?

A. As I told you before that a third substance held it there.

X Q. 107. What was that third substance?

A. That I do not know; I only said it might be a third substance.

X Q. 108. Exhibit 1 states, "that the original mixture of oil and tallow before it was put into the generator dissolved in small proportion when boiled in alcohol." With this statement before you, do you still persist in your statement that solubility in alcohol is a reliable test of the presence of free fat acids?

A. I still persist; and the reason why is, that the proportion of the impurities of the water, I presume, are a great deal larger than
666 the proportion of fat used in the lubricating of the engine; therefore Faraday dissolved a small proportion of the whole, and if the proportion of the impurity is greater than the fat it may be boiled in hot water and it will never separate; but alcohol will dissolve some of the fatty acids, and some of the impurities with it. I have that in the manufacturing of fatty acids, where I have a mixture of copper, lead, and the impurities from the water in which the fat always does adhere to the impurities in a free state; and this is what made me suppose that the fat acids in Faraday's analysis were held in that state.

X Q. 109. Did you ever see a free fat acid that would not melt in boiling water?

A. Not when it is entirely free.

X Q. 110. Did you ever see a free fat acid that had been separated from impurities by being dissolved to a clear solution in hot alcohol and afterwards precipitated from the alcohol by cooling, and melted, which would not melt in boiling water?

A. I have not.

X Q. 111. Do you believe that any such fat acid exists?

A. Not if it is pure.

X Q. 112. Did you ever see a free fat acid that was soluble in alcohol, and was insoluble in ether?

A. I have not.

X Q. 113. Do you believe any such fat acids exist?

A. I do not.

Redirect examination:

Q. 114. Do you not believe that any chemist of ordinary skill could have readily discovered the presence of fat acid and glycerine in the product of the Wilson process, as described in Exhibit No. 21, and as practiced by you in Cincinnati in 1843-4-5?

A. I suppose a chemist who understands his business ought to have detected the smallest proportion of glycerine in the water, as the fat was not subjected to the decomposing heat of the glycerine.

Q. 115. In your cross-examination in answer to question 75, you say

that you first knew the decomposition of fat into fat acids and glycerine by the action of water at a high temperature and pressure—"knowing at the time that such a decomposition had been effected"—in
667 1859 or 1860; do you mean thereby to convey the impression that you did not observe the production of fat acids in the Wilson process, as conducted by you in 1843-4-5?

A. I meant in that answer, practically, I had known in 1843-4 that fat would decompose by heat, water, and pressure.

Q. 116. And how was such knowledge derived?

A. I derived it from the practical working of Wilson's process, as I have formerly stated.

Q. 117. About what percentage of the product of Wilson's process, as conducted by you, was free fat acid?

A. I have never ascertained; but I know that there was the presence of fatty acids.

Q. 118. If neutral commercial fat—that is, fat which has already been rendered—should be submitted to Wilson's process, about what percentage of it would be converted into free fat acids and glycerine, in your opinion?

A. The whole of it could be decomposed into fatty acids and glycerine, if the operation is continued long enough.

Q. 119. Suppose it should be continued for "ten or fifteen hours," at a pressure of from seventy-five to one hundred pounds?

A. I suppose at seventy-five pounds pressure it would decompose one-eighth of it, and at one hundred pounds pressure in proportion to the extra pressure. As the pressure is increased it accelerates the operation.

Q. 120. Does pressure have any effect in the decomposition of fats, except in so far as it itself is the effect of temperature; in other words, if the same heat is applied without pressure, will not the same result be produced—moisture being present?

A. Pressure has no effect upon the fat; it is only the heat and the moisture which affects it. The same effect will be produced if the moisture is kept up to the same heat without the pressure.

F. VERDIN.

Sworn to before me, the 26th day of May, 1869, and subscribed to before me, the 27th day of May, 1869.

CHARLES H. KITCHEL,
Notary Public in and for the City and County of New York.

668 CITY, COUNTY, AND STATE OF NEW YORK, *ss:*

I hereby certify, that before me, Charles H. Kitchel, a notary public in and for the city and county aforesaid, on the 20th day of May, 1869, personally appeared Roland G. Mitchell, named in the foregoing deposition, and was by me first duly and solemnly sworn to testify the truth, the whole truth, and nothing but the truth; and that, on the 26th day of May, 1869, before me, also personally appeared Florence Verdin, named in the foregoing deposition, and was by me first duly and solemnly sworn to testify the truth, the whole truth, and nothing but the truth; that the foregoing depositions were reduced to writing by me in the presence of the witnesses, respectively, and were by them respectively subscribed in my presence; and that I have retained said depositions in my possession, to be sealed up and transmitted to the court.

CHARLES H. KITCHEL,
Notary Public in and for the City and County of New York, residing in the City of New York.

669 Circuit Court of the United States, southern district of Ohio.

RICHARD A. TILGHMAN,
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz. } In equity.

Depositions of J. Lawrence Smith and Edward S. Wayne, taken on behalf of the defendants in the above-entitled cause, before me, L. H. Pummill, a notary public within and for the county of Hamilton, in the State of Ohio, at room No. 76 Burnet House, in the city of Cincinnati; the same having been commenced on the 22d day of June, A. D. 1869, and continued by adjournment from day to day as hereinafter noted.

TUESDAY, *June 22d*, 1869, 2 *p. m.*
BURNET HOUSE.

Present, Benjamin C. Tilghman, esq., on behalf of the complainant; Chas. B. Collier, esq., on behalf of defendants.

Prof. J. LAWRENCE SMITH, being first duly cautioned and solemnly sworn, deposes and says as follows:

In answer to questions propounded to him by counsel for defendants:

Question 1. State your name, age, residence, and occupation.

Answer. My name is J. Lawrence Smith; age, fifty; occupation, that of professional chemist, both scientific and technical; residence, Louisville, Ky.

Q. 2. With whom did you study chemistry, and where; and how long have you been engaged in the profession of scientific and technical chemist?

A. I studied practical chemistry in the laboratories of Liebig in Germany and Pelouze in France; scientific chemistry with Dumas in France, and many other European chemists; among them Chevreul in France, this last, the discoverer of the nature of fatty bodies,
670 and the founder of the application of fatty acids in the arts; have been engaged in scientific and practical chemistry about twenty-seven years.

Q. 3. What positions, if any, have you held in public institutions?

A. I have been professor of chemistry in the Universities of Virginia, Louisiana, and Louisville; director of the Louisville chemical-works, and am now president and technologist for the Louisville gas-works.

Q. 4. What works, or papers, if any, have you written on chemistry?

A. I now produce a printed list of such papers up to within the few last past years. (At the request of the counsel for the defendants the same is hereto annexed, marked Exhibit Smith No. 1.)

EXHIBIT "SMITH" No. 1.

List of discoveries and researches in mineralogy, chemistry, &c., by J. Lawrence Smith, president and engineer of the Louisville Gas-Company; formerly geologist and mining engineer to the Sultan of Turkey; member of the Order of Nichan Iftahar of Turkey; member of the Société de Biologie at Paris, of the Parisian Medical Society; corresponding member of the Boston Society of Natural History, the American Philosophical Society, Société des Sciences et des Artes de Hainaut, American Bureau of Mines, &c.

No. 1. New method of determining alkalies in minerals. Part first.

Quantitative determination of the alkalies in the siliceous minerals, not soluble in acid, with a note on a new method of forming protoxide of nitrogen.—Am. Jour. of Science, vol. 15, pp. 234–243.

No. 2. On the origin of fluorine in fossil bones.—Am. Journal of Science, vol. 48. pp. 99–101.

No. 3. Analysis of the thermal waters of Asia Minor. First part. Waters of Broosa.—Am. Journal of Science, vol. 12, second series, pp. 10–16.

No. 4. The discovery of two new minerals—Liebeigite and medjidite—on Pitchblende, from near Adrianople, Turkey.—Comptes Rendus
671 de l'Academie des Sciences at Paris, 1846; Annalen der Chemie und Pharmacie for 1847; Am. Journal of Science, vol. 5, second series, pp. 336–338.

No. 5. The discovery of chrome ore near Harmonjick, in Asia Minor, and remarks on its geological position.—Am. Jour of Science, vol. 7, second series, p. 285.

No. 6. On the geology, composition, and commercial considerations of emery, from observations made in Asia Minor.—Comptes Rendus de l'Academie des Sciences at Paris, vol. 31; Annales des Mines, vol. 18, fourteenth series, pp. 259–287; Am. Jour. of Science, vol. 10, second series, pp. 354–370.

No. 7. On the minerals discovered in connection with the emery of Asia Minor and the Grecian Archipelago.—Comptes Rendus de l'Academie des Sciences at Paris, vol. 31; Annales des Mines, vol. 18, fourteenth series, pp. 207–387; Am. Jour. of Science, vol. 11, second series, pp. 53–66.

The two last memoirs were originally read before the Academy of Science at Paris, on which a lengthy report was made, through a committee appointed for that purpose, consisting of Messrs. Cordier, Elie de Beaumont, and Dufrenoy, (director of the School of Mines.) The conclusions of the report were as follows:

"It results from the review just given of the labors of Dr. Smith that he has made known—

"1st. The precise nature of the geology of emery in Asia Minor and the Grecian Archipelago;

"2d. That he has described the properties of the principal minerals associated with it, and the manner in which they occur, especially diaspore and emerylite. This last mineral forms, by the identity of its composition in the different formations that the author had occasion to study, a mica constituting a new species and one well determined.

"3d. Finally, that he has given a means of determining the quality of emery, and consequently their commercial value. This process, eminently practical, offers, besides, an interest in a scientific point of view, inasmuch as it permits of the determination of the difference of the tenacity of minerals of equal hardness.

"These researches of geology, mineralogy, and of analytical chemistry, constitute a work of the highest interest, both as a
672 whole, as well as from the new facts they furnish to science. Your committee, consequently, propose to thank Dr. Smith for having communicated them to the Academy, and, in consideration of the importance of the work, to order its insertion in the Recueil des Memoires des Savants etrangers."

No. 8. Warwickite, a boretitanate of magnesia.—Am. Journal of Science, vol. 16, p. 293.

No. 9. Report on the minerals of Chili.—U. S. Astronomical Expedition to Chili.

No. 10. On the geological position of the meerschaum, near Eskisher, in Asia Minor.—Am. Journal of Science, vol. 7, second series, p. 286.

No. 11. Discovery of two new minerals from near Ephesus, in Asia Minor, called emerylite and ephesite.—Am. Journal of Science, vol. 7, second series, p. 285, and vol. 11, pp. 59–62; Annales des Mines, vol. 18, fourteenth series, pp. 294–300.

No. 12. Discovery of a new locality of liebigite.—Am. Journal of Science, vol. 11, second series, p. 257.

No. 13. Analysis of a magnesian opal.—Am. Journal of Science, vol. 5, p. 435.

No. 14. Analysis of the thermal waters of Asia Minor. Second part. Waters of Yalova, Hierapolis, Eskisher, Troy, Mitylene, and Tiberias. —Am. Journal of Science, vol. 12, pp. 366, 367.

RE-EXAMINATION OF AMERICAN MINERALS.

No. 15, part 1. Margarite, aragonite, bowenite, euphyllite, lancasterite, lazulite, mica of Litchfield, oligoclase, uniopite, williamsite.—Am. Journal of Science, vol. 15, pp. 209–215.

RE-EXAMINATION OF AMERICAN MINERALS.

No. 16, part 2. Chesterlite, loxoclase, Danbury feldspars, Haddam albite, Greenwood mica, biotite, margarodite, chesterlite talc, rhodophyllite, cummingtonite, hydrous anthophyllite, monrolite, ozarkite, dysyntribite, gibbsite, emerald nickel.—Am. Journal of Science, vol. 16, pp. 41–58.

RE-EXAMINATION OF AMERICAN MINERALS.

673 No. 17, part 3. Danburite, carrollite, thalite, hudsonite, jenkinsite, lazulite, kyanite, elæolite, spodumene, petalite.—Am. Jour. of Science, vol. 16, pp. 365–375.

RE-EXAMINATION OF AMERICAN MINERALS.

No. 18, part 4. Boltonite, iodid of silver, copiapite, owenite, xenotime, lanthanite, manganese alum, apophyllite, schreibersite, protosulphuret of iron, Cuban.—Am. Journal of Science, vol. 18, pp. 372–381.

RE-EXAMINATION OF AMERICAN MINERALS.

No. 19, part 5. Anglesite, cerusite, wulfenite, vanadate of lead, pyromorphite, mimetene, galena, copper, copper pyrites, malachite, azurite, blende, calamine, hematite, fluor spar, calc spar, sulphur.—Am. Journal of Science, vol. 20, pp. 242–254.

No. 20. On the emery mine of Chester, Hampden County, Mass., with remarks on the nature of emery and its associate minerals.—Am. Journal of Science, vol. 42.

No. 21. New method of determining alkalies in minerals, part second. Conversion of sulphates into chlorides, quantitative determinating of mixed alkalies, separation of the alkaline chlorides, with a more direct method of obtaining them from silicates not soluble in acids.—Am. Journal of Science, vol. 16, pp. 53–61.

No. 22. Discovery of oxide of cobalt at Silver Bluff, South Carolina. —Am. Journal of Science, vol. 48, p. 103.

No. 23. Composition of marl from Ashley River, South Carolina, by which it is shown to contain much phosphate of lime, some ammonia and crenic acid.—Am. Journal of Science, vol. 48, pp. 101–103.

No. 24. Action of oxalic acid on the nitrates and chlorides of sodium and potassium and the reaction of its solution on zinc.—Am. Journal of Science, vol. 17, p. 373.

No. 25. Action of some of the alkaline salts upon the sulphate of lead. —Am. Journal of Science, vol. 47, pp. 81–84.

No. 26. The calcarimetre. A new instrument for estimating the quantity of carbonate of lime in marls and other calcarious substances.—Am. Journal of Science, vol. 46, pp. 262–266.

674 No. 27. A method of getting rid of sal ammoniac in analysis.—Am. Journal of Science, vol. 15, p. 90.

No. 28. Description of five new meteoric irons, with some theoretical considerations connected with meteorites. In two parts.—Am. Journal of Science, vol. 19, pp. 152–163, 323–343.

No. 29. Account of meteoric stones that fell in Harrison County, Indiana, March, 1859, with composition of the same.—Am. Journal of Science, vol. 28, pp. 409–411.

No. 30. Description of three meteoric irons, from Nelson County, Ky., Marshall County, Ky., and Madison County, N. C.—Am. Journal of Science, vol. 30, p. 240.

No. 31. Report on phenomena attending the fall of the Guernsey County, Ohio, meteoric stones, 1860, with analysis of the same.—Am. Journal of Science, vol. 31, pp. 87–98.

No. 32. Description of three new meteorites: Lincoln County, Tenn., meteoric stones that fell August, 1855; Oldham County, Ky., meteoric iron; Robertson County, Tenn., meteoric iron.—Am. Journal of Science, vol. 31.

No. 33. A new meteoric iron, from Wayne County, Ohio. Some remarks on the recently described meteorite from Atacama, Chili.—Am. Journal of Science, vol. 38.

No. 34. A new meteorite from Newton County, Arkansas, containing on i surface carbonate of lime.—Am. Journal of Science, vol. 40.

No. 35. A new meteoric iron from Colorado Territory.—Am. Journal of Science, vol. 43.

No. 36. Chladnite of the Bishopville meteoric stone proved to be a magnesian pyroxene.—Am. Journal of Science, vol. 38.

No. 37. On chromate of potash as a reagent for distinguishing between the salts of baryta and strontia.—Am. Journal of Science, vol. 36, p. 138–148.

No. 38. On the means of detecting arsenic in the animal economy and of counteracting its effects. First part.—Am. Journal of Science, vol. 60, pp. 278–293.

No. 39. On the means of detecting arsenic in the animal economy and of counteracting its effects. Second part.—Am. Journal of Science, vol. , pp. 75–81.

675 No. 40. On the action of potash upon cholesterine.—Am. Journal of Science, vol. 44, pp. 60–63.

No. . On the composition of spermaceti, and the products of its distillation, with some remarks on its decomposition by nitric acid; resulting in a complete change of the chemical history of spermaceti, and added by Berzelius in the sixth volume of his last edition of Chemis.—Annalen der Chemie und Pharmacie, 1842; Annales de Chemie de Physique, 1842; Am. Journal of Science, vol. 43, pp. 301–320.

No. 42. Action of nitric acid on the chlorides of sodium and potassium.—Am. Journal of Science, vol. 16, p. 373.

No. 43. Analysis of the cotton-plant and forty varieties of cotton-soils, with some remarks on the nature of rust in cotton.—Southern Agriculturist for 1846.

No. 44. The discovery of sulphate of iron and of alum in rice-fields soils, and the indirect effects of drought on rice-lands, with the manner of counteracting its effects.—Southern Agriculturist for 1846.

No. 45. Action of the solution of the neutral phosphates of the alkalies upon carbonate of lime and some other insoluble carbonates.—Am. Journal of Science, vol. 48, pp. 97–98.

No. 46. A new method of making permanent artificial magnets by galvanism.—Am. Journal of Science, vol. 36, pp. 336–337.

No. 47. A new method of freezing water under the receiver of an air pump, without the aid of sulphuric acid or other desiccating agent.—Am. Jour. of Science, vol. 1, second series, p. 265; Southern Journal of Med. and Pharmacy for 1846.

No. 48. Report on Dupont's artesian well, at Louisville.—Am. Journal of Science, vol. 27, pp. 184–278.

No. 46. The inverted microscope, (a new form of microscope,) with the description of a new eye-piece micrometer, and a new form of goniometer for measuring the angles of crystals under the microscope.—Proc. Société de Biologie at Paris, 1850; Proc. of the Am. Scientific Association, 1851; Am. Journal of Science, vol. 14, second series, p. 233–241.

676 Q. 5. Are you acquainted with the various processes employed heretofore and at present, in the manufacture of fatty acids and glycerine, and for preparing fats for manufacture into candles; and if you are acquainted with such processes, please state your source of information, whether you are both theoretically and practically acquainted therewith, and whether or not your attention has been specifically directed to such branch of chemical industry?

A. I consider myself familiar with the processes that have been and are now employed for the manufacture of fatty acids and glycerin for the various purposes to which they are applied in the arts.

My sources of information in such branches of industrial chemistry have been from my studies in the laboratories of distinguished chemists and manufacturers who have devoted their attention to this subject, such as Liebig and Pelouze, of Germany and France; also from the careful study of the labors of Chevreul in France, and from my observations in the great candle-factories of Price and Company in Battersea, near London, and in the original star-candle factory of Deilly, on the barrière de l'Etoile, in Paris; in this last candle-factory the practical knowledge I obtained has been most thorough and complete, through the kindness of my personal friend DeMilly, the founder and owner of the establishment. My attention has been for a period of years directed to this branch of industry.

Q. 6. Have you filled any position as committee to investigate and report upon this branch of industrial chemistry, under appointment from any scientific body? If yea, please state what appointment you have so filled, and whether you have made any report under the same.

A. In 1867, I was appointed by the general council of the Paris exposition (of which I was a member, and at the same time vice-president of the jury of the chemical department) to make a report for the imperial commission of said exposition, on the fatty acids and candles then exhibited, together with a full report on the progress of this

branch of industry in the world, since 1862. I was also appointed by the American commission to said exposition to make a more extended report on the same subject in connection with industrial chemistry, at that time; the report for the imperial commission has been pub-
677 lished in the sixth volume of their reports, that for the American commission is now in course of publication.

Q. 7. Will you please describe the different processes that have been and are now employed for the decomposition of fats, and the production therefrom of fatty acids, or fatty acids and glycerine?

A. There have been a variety of processes for the decomposition of fats into acids and glycerine. In some, the acids alone being sought after, and in others, both the acids and glycerine are recovered. The processes applied in manufactural chemistry, and known under the general term of saponification of the fats have been: First, by decomposition of the fats with alkalies, alkaline earths, and other bases in conjunction with water and heat, either in open vessels or under pressure. This was first applied in 1825, by Chevreul and Gay-Lussac, and has been subjected to various modifications since. Secondly, by heating the fats and distilling the same over a naked fire without the presence of water, as found in the specifications of Moses Poole, in 1825, to be found in Stas' reports on stearic acid, made in the exposition report at Paris, 1855. Thirdly, by heating the fats to a high temperature, and passing superheated steam through them first sketched out in 1825, by Chevreul and Gay-Lussac, and afterward carried out with various improvements and modifications in France and England, especially by E. Price and Company in 1842, Scharling in 1850, and finally by George Wilson and Payne in 1854. Fourthly, by heating the fats with sulphuric acids, (containing two equivalents of water,) and by subsequent distillation, the fat acids are obtained and the glycerine destroyed. It has been carried on successfully and extensively since about 1846. Fifthly, by heating the fats to a high temperature in contact with water in close vessels, first noticed by Farad'y, in 1823, as taking place in Perkins' engine, and subsequently applied practically by R. A. Tilghman, in the United States, and a little later by Melsens, in Belgium; by this process both the fat acids and glycerine are obtained. Sixthly, by heating the fats to a high temperature in contact with a small quantity of lime and water in a close vessel into which superheated steam is passed, first marked out by Gay-Lussac, in his original patent,
678 in 1825, and made practical by DeMilly, in 1855, and practiced more or less extensively in various parts of the world; in this both the fat acids and glycerine are obtained. Seventhly, saponification by heating with sulphuric acid (containing two equivalents of water) for a very short period of time under peculiar circumstances, by which the fat acids procured are at once subjected to pressure without previous distillation; this is a recent invention of De Milly, having, as yet, but limited application.

I might mention yet other proposed processes of saponification of fats for candle purposes, but as they never received any technical application it is useless to refer to them. Of the above methods, those employed in practice are, first, the lime saponification; second, sulphuric acid saponification; third, saponification in closed vessels, at a very high heat, with water; fourth, saponification in closed vessels with high heat, lime, and water; all four of which methods are distinct in their character, each having its merits and demerits.

Q. 8. Have you read, and do you understand the letters-patent issued to the complainant herein, Richard A. Tilghman, bearing date October 3d, 1854, and numbered 11776?

A. I have read the letters-patent and think I understand them.

Q. 9. Have you read, and do you understand, the original application of Richard A. Tilghman for said letters-patent as obtained in the official certified copy of such application?

A. I have read the certified copy, and think I understand that.

Q. 10. Have you read the descriptions of the processes of the defendants, as set forth in their original and supplemental answers in this suit; and do you understand the nature of the processes so described?

A. Yes, I have read the descriptions, and believe that I understand them fully.

Q. 11. Have you seen and examined defendants' processes, as practically carried on?

A. I have seen and examined such processes as practically carried on in the factory of Messrs. Werk & Co., at Cincinnati; also, I have seen a similar process, as practiced in the candle-factory of DeMilly, at Paris.

Q. 15. Having read and understanding, as you state, the complainant's letters-patent, and understanding also, as you state, the pro-
679 cess of the defendants as described in their original and supplemental answers; will you please state whether or not, in your opinion, the said processes of the defendants are, or is either of them, substantially the same in principle, mode of operation, and results produced, as the process described in the complainant's said patent; and in expressing your opinion in answer hereto, will you please mention any facts which you may have observed and describe any experiments which you may have conducted from which the opinion which you have formed, and may express, is derived.

A. In answering this question it will require a review of the entire subject as I have investigated it, and will be quite lengthy, for I am not able to curtail it.

R. A. Tilghman, in his letters-patent, describes a process for producing from fatty bodies free fat acids and a solution of glycerine by subjecting said fatty bodies to the action of a high temperature and pressure in the presence of water; that temperature is embraced within certain limits, namely: from the melting-point of tin (440° Fa'r.) to the melting-point of nitre, (660° Fa'r.,) which temperature is further explained in the original application for letters-patent by the complainant in relation to forming soap by heating fats with the carbonate of the alkali, (which application I have carefully read,) where he states "that the degree of heat required is less than that which is necessary to produce fat acids, and should generally be kept between the melting-points of tin and bismuth, (440° Fa'r. and 510° Fa'r.) At about 350° Fa'r. the neutral fats will form soaps with the alkaline carbonates, but a higher temperature will produce the result more quickly." Still further in the letters-patent originally referred to, the complainant states: "the melting-point of lead has been mentioned as the proper heat to be used in the operation, because it has been found to give good results, but the change of fatty matter into fat acids and glycerine takes place with some materials (such as palm oil) at or below the melting-point of bismuth, (510° Fa'r.,) etc." And furthermore in the patent of the complainant it is stated that the mixture of fat and water should be exposed to the desired temperature for ten minutes.

So, then, the first point of difference which I observe between the processes of the complainant and defendants is the great difference in
680 the temperature at which the decomposition is effected in the

two cases; in the complainant's case the temperature ranging from 440 to 660 deg. Fa'r., and in the defendants' process about 320° Fa'r.; and, secondly, the relative time required by each process; the complainant's process requiring ten minutes, and the defendants' process eight hours. The third point of difference in the two processes is the difference in the character of the vessels required; the complainant requiring vessels of immense strength, for he speaks of testing them by way of precaution with 10,000 pounds pressure to the square inch, while the "working pressure" "will not be found to exceed 2,000 pounds to the square inch," while the defendants' vessels are of the strength of the ordinary boiler, in fact, the boilers furnishing both steam and pressure being a battery of ordinary boilers; such vessels as are used by the defendants would be worse than useless in carrying out the specifications of complainant's patent. Fourth point of difference is in the agents employed by the complainant and by the defendents; the former using great heat and liquid water only; the defendants using a moderately high temperature, lime, water, and steam, these agents acting in conjunction in bringing about the final result, namely, the complete decomposition of the fats. As regards the respective part that each plays, I do not believe that any chemist can give a reliable explanation in our present state of knowledge. The late distinguished French chemist, Pelouze, in some researches, made in 1855, on this subject, namely, the decomposition of the fats by a small quantity of an alkali or other base under pressure, aided by heat and water, attributes the decomposition to the base only. Other chemists attribute the decomposing action to the steam to a considerable extent; others to the heat, and others to the liquid water. I myself, from experiment and reflection, consider that the heat has a more powerful decomposing action than any other agent employed in the defendants' process, except it be the lime, and what I here state, with reference to the powerful decomposing action of heat alone, has much to do with what takes place in the complainant's process. In what I state with reference to the decomposing power of heat, I would be understood to mean that heat is the only agent, when employed alone, that can accomplish a nearly complete decomposition of the fats. Lime and sulphuric acid will do it without heat, but only to a very limited extent, and after a prolonged
681 action; while pure water alone without heat has no action upon the fats, except it may be to an exceedingly small extent. But the safest theoretical deduction for any chemist to make is that these different agents aid one another in some manner or other, for no one of them alone can produce what their combined action accomplishes. As regards what action the water has in the defendants' processes, as this substance, water, is to be found in those processes both as a liquid and as steam, (the last constantly bubbling through and agitating the whole mass.) I should certainly attribute whatever action the water may have almost, if not exclusively, to that substance in the form of steam; especially so when sustained by the experiments of Scharling, in 1850, and George Wilson and Payne, in 1854. Besides, steam is a more favorable form for water to produce chemical action, and we know that the acids and glycerine do not exist ready formed in the fats as we find them when separated, it requiring the elements of the water to form free fat acids and glycerine; and, from the time soaps were first formed to the present day, water had to be present in some form or other whether saponification was produced by potash, lime, acid, or heated steam, and the more finely divided the particles of water the more readily would they combine with the fats when the other requisites of

saponification were brought to bear upon the fats. As regards my theoretical opinion of the operation in the defendants' processes, (where lime is used in quantities insufficient to produce a neutral soap with the fat acids,) I had not ventured to form any, and am deterred for the present from putting my name to any theory, familiar as I am with the great theoretical blunders made by chemists upon some of the commonest chemical arts, as, for instance, Le Blanc's process for making soda. Although the process is fully eighty years old, it has had many theoretical explanations by the ablest chemists which have been successively set aside, and it is now considered that the theory of Kopp, made but two or three years ago, is doubtless nearer the truth than any other; and what is true of the art of making soda from common salt is true of many other manufactural processes. But of one thing I am, at present, convinced, after numerous experiments in my own laboratory and careful scrutiny of the defendants' operation, as conducted in the factories of De Milly, in France, and defendants, in Cincinnati,
682 namely, that in no stage of the process is the lime without action, either at the commencement of the operation when the lime is uncombined, or in the middle, or in the end of the operation after the lime has formed a soap with the fat acids. One fact I may state in this connection. I had introduced into the large digester, in the factory of the defendants, the usual amount of fat for one charge, six thousand pounds, and four hundred and eighty gallons of water, but used no lime; the other conditions remained the same as those employed by the defendants in their operations with the lime. I examined the boilers, pressure-gauges, safety-valves on the digester, the pressure and the heat employed, visiting the digester and boilers every half hour, continually watching it for eight hours; the temperature in the digester corresponded to a pressure of about 70 pounds, a temperature under 320° Fa'r. The pressure in the boiler, as indicated by one of Ashcroft's steam-gauges recently inspected by Miles Greenwood, indicated 82 pounds pressure. The valve of the digester, which I have stated indicated a pressure of about 70 pounds, was constantly blowing off immense quantities of steam, so much so as to make it necesssry for me to approach within 12 inches of the valve-lever in my frequent inspections of the same during the operation. I would state that I had the safety-valve detached, measured it myself, measured the length of the lever-weight attached to same, so that I might know positively the temperature and pressure from personal knowledge. At different stages of the process, during the eight hours, I drew off samples for examination that were subsequently analyzed by me in my laboratory. The free fat acid found in the specimens was small; the largest amount was that contained in the mass after eight hours' action, this amounting to a little over ten per cent. of the original fat, thus leaving nine-tenths of the fat unaltered; so that at the temperature that defendants operate with it would require eight hours to decompose the entire mass without lime. Now, when the defendants' use enough lime to form a neutral soap, with only four-tenths of the fat, the other six-tenths are yet completely changed into fat acids and glycerine in seven or eight hours, which could not be the case if, as some assume, the lime exerts no further action in the operation when once it has formed a neutral soap; for, according to this view of the subject, it would require with the
683 four per cent. of lime forty-eight hours for complete saponification, while, in fact, it is all accomplished in eight hours. All of which goes to prove that the lime exerts an influence upon the entire mass of fat, even to the end of the operation; and in this opinion I am

sustained by Professor Rogers, one of the complainant's witnesses in this suit when responding to certain statements of Mr. Ropes analogous to the statements I have just made. Professor Rogers says, in answer to cross-question 100, "I infer, assuming the correctness of Ropes' statements, that the small quantity of lime exerts an influence which ends in the conversion of the entire mass of fat and acids, the result which is obtained upon the whole mass."

My experiments on this subject were numerous, and made in two vessels that I had constructed for the purpose, and whenever I desired to compare two different processes these vessels were used simultaneously and placed together in a proper arranged heater to keep the two vessels at the same temperature for any given length of time, they being frequently agitated in such manner as not to interfere with their being kept at uniform temperature.

I will refer to but two or three of these experiments: Vessel number 1 contained water and fat, with a space above them in which steam could collect; number 2 contained water, fat, a space for steam, and a small quantity of neutral lime-soap previously prepared, chemically pure. The vessels were elongated cylinders of gun-metal, one fourth of an inch in thickness, about seven inches in length, and an inch and a quarther inside diameter, with strong flange at the open end, that was closed with a thick plate of gun-metal, fastened down by a powerful cross-head screw, with a gasket of thin lead between the cover and cylinder; the vessels were heated in a large bath of paraffine by the aid of a gas-burner, and agitated by a spring bow overhead when required; the agitation was made once an hour for 20 or 30 seconds at each time, the tubes being vertical. The materials experimented with were introduced into the cylinder directly, or in glass tubes that were placed in the copper cylinder; the vessels, Nos. 1 and 2, with their contents referred to above, were exposed to a temperature of 320° Fa'r., for eight hours; after which they were opened, the contents of the vessel No. 1 was decomposed only to the extent of one-tenth of the fat, while in ves-
684 sel No. 2, where I used a little neutral lime-soap, there was but a trace of undecomposed fat. In another set of experiments using in No. 2 four per cent. of lime, No. 1 having only water and fat, the amount of fat acids liberated ranged from ten to thirteen per cent., while the decomposition in No. 2 was what would be practically called complete. These and several other experiments are perfectly in accord with those made by Pelouze, and referred to by him in his remarks "On the saponification of fatty bodies by the soaps," and communicated by him to the Academy of Sciences of Paris, December, 1855; they also agree with the observations made by Stas in 1855, in the factory of DeMilly, and recorded in his report on the chemical products of the exposition at Paris, in 1855, and with my own observations in the same factory in 1867.

To sum up in a few words my opinion of the processes of complainant and defendants, I would state—

First. That each process is based on facts observed many years ago, by one or more individuals, however new they may be to either of the parties to this suit.

Secondly. That the materials and agents employed by them, respectively, constitute them two distinct and dissimilar processes.

Thirdly. That in the temperatures and time required, and nature and strength of vessels employed in the two processes respectively, there is a wide difference.

Fourthly. As to the nature and sequence of chemical changes in the

processes of the complainant and defendants, while they are surrounded with a degree of obscurity that should make chemists cautious in too positive assertions of their theoretical deductions, yet there is sufficient light thrown on the subject by my own experiments, and those of distinguished chemists, to sustain me in the conclusion that the complainant's and defendants' processes are dissimilar, both theoretically and practically.

Here adjourned until Wednesday, June 23d, 1869, at 10 a. m.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

685 Met pursuant to adjournment.

Q. 13. What method of analysis did you submit the products of your experiments to, in order to ascertain the relative percentage of free fat acids produced, and of undecomposed fat?

A. In analyzing the products of decomposition in my experiments, I proceeded as follows: I heated material to be analyzed in a glass flask, with about 20 to 30 times as much water as there was fat employed; the water was brought to a temperature of about 150° Fa'r., and then a very thin milk of lime was added, in very small portions at a time, to the heated water and fat, agitating thoroughly after each addition. There was an excess of milk of lime added over and above what would be required to combine with all the acids of the fat. After thorough agitation, the water was allowed to cool to the ordinary temperature and thrown upon a filter; the water passed through, leaving on the filter the lime-soap, the excess of lime, and some fat, if all of this last had not been decomposed, (some of the undecomposed fat sticks to the inside of the flask:) the filter was laid aside with its contents, on several thicknesses of filter paper, and left to dry in the temperature of the surrounding air. This required usually from two to four days. I next used as a solvent pure redistilled benzole; this was added to the flask in sufficient quantity, say, from ten to twenty times the amount of fat used, and gently warmed to about 120°; this solution was poured into a glass beaker, and the flask washed out once or twice with a little more benzole, which was added to the first portion. A little lime-soap was often found adhering to the vessel, but came out with the benzole solution in a state of suspension. The benzole solution was set aside, when the little lime-soap it contained settled, out from which the benzole solution was decanted, and the lime-soap further washed by the same process. I next proceeded to treat the dried contents of the filter with benzole in the same manner, and by repeated washing and settling the lime-soap was purified. Finally all the benzole solutions of the first and second part of the operation was heated, the benzole being driven off, and the undecomposed fat remaining behind; the lime-soap which was not dissolved by the benzole was thrown on a filter, and after the little benzole remaining in it passed through the filter, the filter and its contents
686 was dried in the air, (which desiccation is accomplished in a few hours;) the dry lime-soap was then moistened with alcohol and decomposed with water and hydrochloric acid, heated to about 212° Fa'r.; the free fat acids now rose to the surface, and after the whole was cooled down to 50 or 60° Fa'r., the fat acids were collected from the surface of the liquid and weighed. Of course this process was modified according to the nature of the analysis required to be made, which modification was such as would suggest itself to any analytical chemist. The milk of lime was added to combine with any pre-existing free fat acids in the compounds under analysis, and the milk of lime thus added, at about 150°

Fa'r., has no sensible chemical action in decomposing the fats, except after long-continued action.

Q. 14. Does the apparatus or digester of the defendants bear any resemblance to the tube or coil apparatus described in complainant's patent and shown in the drawings annexed thereto?

A. It does not.

Q. 15. Would such coil-apparatus be a suitable form of apparatus in which to carry on, practically, the process of the defendants?

A. It would not.

Q. 16. In the letters-patent of the complainant, another kind of apparatus, aside from the coil-apparatus, is contemplated, and is referred to in the following words as contained in said patent, to wit: "I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting-point of lead, until the operation is complete. The vessel must be closed and of great strength so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam." Is the apparatus or digester of the defendants such a "convenient vessel" as described in the complainant's patent; and could the conditions as specified in said patent relative to such "convenient vessel" exist in the apparatus of the defendants?

A. The apparatus of the defendants is not such a convenient apparatus as described in the letters-patent; the conditions could not be realized in defendants' apparatus, it being of a strength not exceeding that required for the pressure that ordinary steam-boilers have to
687 sustain. Whereas, any apparatus, to accomplish the results as set forth in the letters-patent, would be required to be of enormous strength, surpassing that of any steam-vessel in ordinary use.

Q. 17. Could a vessel of the diameter and size of the defendants' digester, be employed under the conditions specified in the complainant's patent?

A. It most certainly could not. The digester, however strong it might be, is but a part of the apparatus of which the boilers are a part, the boiler and the digester being in free communication, one with another, the strength of the apparatus cannot be measured by any other rule than that the weakest point of a vessel under pressure, is the true measure of the strength of said vessel, and I suppose that no boiler-inspector would rate the boilers in defendants' works, beyond 120 to 140 pounds safe pressure.

Q. 18. Could a vessel or digester of the diameter of that employed by the defendants be constructed so as to answer the requirements of the "convenient vessel" described in complainant's patent, even though the heat applied to it was by extraneous fire, and not communicated from separate steam-boilers?

A. Certainly it could, by making it of wrought iron, a number of inches in thickness.

Q. 19. And what do you say as to the practicability thereof?

A. I would say that it was a very impracticable, but not an impossible thing.

Cross-examination by B. C. Tilghman, esq., attorney for complainant.

X Q. 20. Were not most of the questions which have been asked you by the counsel for the complainant, prepared in writing and submitted to you prior to commencing the taking of your deposition in this case?

A. When I came to Cincinnati, on Monday, June 21st, I had neither questions suggested nor answers prepared. The substance of my in-

vestigation and experiments were fully made out in writing, and a short while before giving my evidence the counsel for the defendants was made acquainted by me with the facts and statements I had pre-
688 pared to submit in evidence, upon which the defendants' counsel propounded the questions.

X Q 21. How long a time have you been engaged in making investigations and experiments in this present suit?

A. About two months.

X Q. 22. As a technical and scientific chemist, do you not consider that the most reliable and satisfactory method of giving testimony as to scientific questions, is to prepare the answers deliberately, and in writing?

A. It certainly is to the chemist.

X Q. 23. Was the method of analysis described in your 13th answer-in-chief, that which was introduced by the French chemist, Berthelot, in his investigation of fatty substances?

A. The method of analysis was marked out by myself in all its details, and carried into effect, when it occurred to me that Berthelot had employed a method somewhat similar, but so satisfied was I with the results obtained in the method pursued by me, that I gave myself no further thought on the subject, not caring whether the method was new or old, so long as it gave me, as I believed, accurate results.

X Q. 24. Does not the accuracy of the method of analysis used by you, depend*ed* entirely upon the insolubility of the lime-soaps in benzole?

A. It does.

X Q. 25. Is benzole the same substance as that which is called benzine by the French chemists?

A. The benzole I used was the light volatile hydro-carbon distilled from petroleum oil, and boiling at a temperature of about from 130 to 160° Fa'r.; the benzole from coal tar is a different product from the one used in my experiments, but I believe would answer quite as well. The benzole employed was carefully rectified by me in my laboratory.

X Q. 26. About how much benzole did you use in dissolving and washing your fatty substance, in proportion to the weight of said fatty substance?

A. From about 30 to 35 parts; the first treatment consuming proportionally the largest amount; for when once the bulk of fats soluble in benzole was removed, the further washing required very small additions each time.

X Q. 27. From your examination of the product of defendants'
689 process (prepared with four per cent. of lime, as described in their supplementary answer,) it consists of about 40 per cent. of lime-soap, and about 60 per cent. of free fat acids, does it not?

A. The mixture in the defendants' process consisted of 4 parts of lime and about 100 parts of fat acids, less the amount of glycerine contained in the fat originally used; the original materials employed being 100 parts of neutral fat and 4 parts of lime.

X Q. 28. How many parts of said fat acid (if any) were saturated, or neutralized by the 4 parts of lime?

A. To make what is called a neutral lime-soap with the 4 parts of lime employed, it would require about 40 parts of fat acid; there were 40 parts of fat acid found in the lime-soap separated by my process of analysis. By this, however, I do not mean to assert that the product as it came from the digester contained the lime, in the condition of a neutral lime-soap.

X Q. 29. In what chemical condition were the remaining 60 parts of

clear solution contain only the free fat acid portion of the scum, or did it contain also the lime and metallic soap portion thereof?

A. It must have contained some of the lime and metallic soap, or the fatty acids would have come out of the usual color of fatty acids.

664 X Q. 95. Then lime and metallic soaps are soluble in hot alcohol, as well as free fat acids: is that so?

A. I know lime-soap is not soluble in hot alcohol; as for metallic soap, I have never tested it, and do not know.

X Q. 96. Then you know that the clear, hot alcoholic solution contained no lime-soap; is that so?

A. It may have contained some lime-soap, but the lime-soap was perhaps not in the same condition as that which I have tested.

X Q. 97. At this moment do you know whether lime-soap is soluble in hot alcohol or not?

A. I have always understood that it was not.

X Q. 98. And your present belief is that lime-soap is not soluble in hot alcohol; is that your belief?

A. That is my belief; and if it is soluble, it is so only to a small extent.

X Q. 99. Exhibit 1 says that the hot alcoholic solution from the black scum, when cool, let fall flocculi in abundance, which, when collected and fused, gave a "grayish substance." In your opinion, what was the chemical nature of this "grayish substance," judging from all that is said of it in the exhibit?

A. In my opinion it was still a mixture of the fatty acids and impurities of the water.

X Q. 100. What do you understand from the exhibit to have been the properties of the "grayish substance"? Name all that are described.

A. I understand it contracted and cracked as it cooled, and had the lustre and appearance of wax, but was rather more brittle. It did not melt in boiling water, but did at a higher heat, and ultimately it burned like fat. It was rather lighter than water, and dissolved readily in alkalies—more readily, the author thinks, than fat, and in that respect the author thinks it resembles Chevreul's acids of fat, as well as in its solubility in alcohol. The alkaline solution was turbid. It was not soluble in ether, or very slightly so; when burnt, it left an ash consisting principally of carbonate of lime.

X Q. 101. Is it your opinion that the "grayish substance" contained some lime-soap mixed with some free fatty acids?

A. That is my opinion.

665 X Q. 102. As the "grayish substance" is described as being soluble in alcohol, then lime soap, as well as free fat acid, must be soluble in alcohol, must it not?

A. I said once before that that lime-soap may have been in a different condition from the one I have tested. In a chemical composition the slightest presence of another substance changes the whole composition.

X Q. 103. As the "grayish substance" is described as being soluble in alcohol, then that particular kind or condition of lime-soap existing in it, as well as the fat acid existing in it, must both have been soluble in alcohol, must they not?

A. The one particular kind of substance may have the power to make the other substance soluble in alcohol, and with this explanation they both were soluble in alcohol.

X Q. 104. In that case, then, was solubility in alcohol a reliable test—that the matter dissolved was free fat acid?

A. I believe it was; and they (the fatty acids) were only combined mechanically with the carbonate of lime.

X Q. 105. Then, if the fatty acid was only combined mechanically with the carbonate of lime, there was really no lime-soap present at all, was there?

A. I suppose there was not. It is not always the case when you find carbonate of lime that neutral lime-soap has been present.

X Q. 106. Then, if no lime-soap was present, but only mechanically-mixed carbonate of lime, how did the carbonate of lime exist in the clear, hot alcoholic solution from which this "grayish substance" was obtained?

A. As I told you before that a third substance held it there.

X Q. 107. What was that third substance?

A. That I do not know; I only said it might be a third substance.

X Q. 108. Exhibit 1 states, "that the original mixture of oil and tallow before it was put into the generator dissolved in small proportion when boiled in alcohol." With this statement before you, do you still persist in your statement that solubility in alcohol is a reliable test of the presence of free fat acids?

A. I still persist; and the reason why is, that the proportion of the impurities of the water, I presume, are a great deal larger than
666 the proportion of fat used in the lubricating of the engine; therefore Faraday dissolved a small proportion of the whole, and if the proportion of the impurity is greater than the fat it may be boiled in hot water and it will never separate; but alcohol will dissolve some of the fatty acids, and some of the impurities with it. I have that in the manufacturing of fatty acids, where I have a mixture of copper, lead, and the impurities from the water in which the fat always does adhere to the impurities in a free state; and this is what made me suppose that the fat acids in Faraday's analysis were held in that state.

X Q. 109. Did you ever see a free fat acid that would not melt in boiling water?

A. Not when it is entirely free.

X Q. 110. Did you ever see a free fat acid that had been separated from impurities by being dissolved to a clear solution in hot alcohol and afterwards precipitated from the alcohol by cooling, and melted, which would not melt in boiling water?

A. I have not.

X Q. 111. Do you believe that any such fat acid exists?

A. Not if it is pure.

X Q. 112. Did you ever see a free fat acid that was soluble in alcohol, and was insoluble in ether?

A. I have not.

X Q. 113. Do you believe any such fat acids exist?

A. I do not.

Redirect examination:

Q. 114. Do you not believe that any chemist of ordinary skill could have readily discovered the presence of fat acid and glycerine in the product of the Wilson process, as described in Exhibit No. 21, and as practiced by you in Cincinnati in 1843–4–5?

A. I suppose a chemist who understands his business ought to have detected the smallest proportion of glycerine in the water, as the fat was not subjected to the decomposing heat of the glycerine.

Q. 115. In your cross-examination in answer to question 75, you say

that you first knew the decomposition of fat into fat acids and glycerine by the action of water at a high temperature and pressure—"knowing at the time that such a decomposition had been effected"—in
667 1859 or 1860; do you mean thereby to convey the impression that you did not observe the production of fat acids in the Wilson process, as conducted by you in 1843–4–5?

A. I meant in that answer, practically, I had known in 1843–4 that fat would decompose by heat, water, and pressure.

Q. 116. And how was such knowledge derived?

A. I derived it from the practical working of Wilson's process, as I have formerly stated.

Q. 117. About what percentage of the product of Wilson's process, as conducted by you, was free fat acid?

A. I have never ascertained; but I know that there was the presence of fatty acids.

Q. 118. If neutral commercial fat—that is, fat which has already been rendered—should be submitted to Wilson's process, about what percentage of it would be converted into free fat acids and glycerine, in your opinion?

A. The whole of it could be decomposed into fatty acids and glycerine, if the operation is continued long enough.

Q. 119. Suppose it should be continued for "ten or fifteen hours," at a pressure of from seventy-five to one hundred pounds?

A. I suppose at seventy-five pounds pressure it would decompose one-eighth of it, and at one hundred pounds pressure in proportion to the extra pressure. As the pressure is increased it accelerates the operation.

Q. 120. Does pressure have any effect in the decomposition of fats, except in so far as it itself is the effect of temperature; in other words, if the same heat is applied without pressure, will not the same result be produced—moisture being present?

A. Pressure has no effect upon the fat; it is only the heat and the moisture which affects it. The same effect will be produced if the moisture is kept up to the same heat without the pressure.

F. VERDIN.

Sworn to before me, the 26th day of May, 1869, and subscribed to before me, the 27th day of May, 1869.

CHARLES H. KITCHEL,
Notary Public in and for the City and County of New York.

668 CITY, COUNTY, AND STATE OF NEW YORK, *ss:*

I hereby certify, that before me, Charles H. Kitchel, a notary public in and for the city and county aforesaid, on the 20th day of May, 1869, personally appeared Roland G. Mitchell, named in the foregoing deposition, and was by me first duly and solemnly sworn to testify the truth, the whole truth, and nothing but the truth; and that, on the 26th day of May, 1869, before me, also personally appeared Florence Verdin, named in the foregoing deposition, and was by me first duly and solemnly sworn to testify the truth, the whole truth, and nothing but the truth; that the foregoing depositions were reduced to writing by me in the presence of the witnesses, respectively, and were by them respectively subscribed in my presence; and that I have retained said depositions in my possession, to be sealed up and transmitted to the court.

CHARLES H. KITCHEL,
Notary Public in and for the City and County of New York, residing in the City of New York.

669 Circuit Court of the United States, southern district of Ohio.

RICHARD A. TILGHMAN,
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz. } In equity.

Depositions of J. Lawrence Smith and Edward S. Wayne, taken on behalf of the defendants in the above-entitled cause, before me, L. H. Pummill, a notary public within and for the county of Hamilton, in the State of Ohio, at room No. 76 Burnet House, in the city of Cincinnati; the same having been commenced on the 22d day of June, A. D. 1869, and continued by adjournment from day to day as hereinafter noted.

TUESDAY, *June 22d*, 1869, *2 p. m.*
BURNET HOUSE.

Present, Benjamin C. Tilghman, esq., on behalf of the complainant; Chas. B. Collier, esq., on behalf of defendants.

Prof. J. LAWRENCE SMITH, being first duly cautioned and solemnly sworn, deposes and says as follows:

In answer to questions propounded to him by counsel for defendants:

Question 1. State your name, age, residence, and occupation.

Answer. My name is J. Lawrence Smith; age, fifty; occupation, that of professional chemist, both scientific and technical; residence, Louisville, Ky.

Q. 2. With whom did you study chemistry, and where; and how long have you been engaged in the profession of scientific and technical chemist?

A. I studied practical chemistry in the laboratories of Liebig in Germany and Pelouze in France; scientific chemistry with Dumas in France, and many other European chemists; among them Chevreul in France, this last, the discoverer of the nature of fatty bodies,
670 and the founder of the application of fatty acids in the arts; have been engaged in scientific and practical chemistry about twenty-seven years.

Q. 3. What positions, if any, have you held in public institutions?

A. I have been professor of chemistry in the Universities of Virginia, Louisiana, and Louisville; director of the Louisville chemical-works, and am now president and technologist for the Louisville gas-works.

Q. 4. What works, or papers, if any, have you written on chemistry?

A. I now produce a printed list of such papers up to within the few last past years. (At the request of the counsel for the defendants the same is hereto annexed, marked Exhibit Smith No. 1.)

EXHIBIT "SMITH" NO. 1.

List of discoveries and researches in mineralogy, chemistry, &c., by J. Lawrence Smith, president and engineer of the Louisville Gas-Company; formerly geologist and mining engineer to the Sultan of Turkey; member of the Order of Nichan Iftahar of Turkey; member of the Société de Biologie at Paris, of the Parisian Medical Society; corresponding member of the Boston Society of Natural History, the American Philosophical Society, Société des Sciences et des Artes de Hainaut, American Bureau of Mines, &c.

No. 1. New method of determining alkalies in minerals. Part first.

Quantitative determination of the alkalies in the siliceous minerals, not soluble in acid, with a note on a new method of forming protoxide of nitrogen.—Am. Jour. of Science, vol. 15, pp. 234–243.

No. 2. On the origin of fluorine in fossil bones.—Am. Journal of Science, vol. 48. pp. 99–101.

No. 3. Analysis of the thermal waters of Asia Minor. First part. Waters of Broosa.—Am. Journal of Science, vol. 12, second series, pp. 10–16.

No. 4. The discovery of two new minerals—Liebeigite and medjidite—on Pitchblende, from near Adrianople, Turkey.—Comptes Rendus
671 de l'Academie des Sciences at Paris, 1846; Annalen der Chemie und Pharmacie for 1847; Am. Journal of Science, vol. 5, second series, pp. 336–338.

No. 5. The discovery of chrome ore near Harmonjick, in Asia Minor, and remarks on its geological position.—Am. Jour of Science, vol. 7, second series, p. 285.

No. 6. On the geology, composition, and commercial considerations of emery, from observations made in Asia Minor.—Comptes Rendus de l'Academie des Sciences at Paris, vol. 31; Annales des Mines, vol. 18, fourteenth series, pp. 259–287; Am. Jour. of Science, vol. 10, second series, pp. 354–370.

No. 7. On the minerals discovered in connection with the emery of Asia Minor and the Grecian Archipelago.—Comptes Rendus de l'Academie des Sciences at Paris, vol. 31; Annales des Mines, vol. 18, fourteenth series, pp. 207–387; Am. Jour. of Science, vol. 11, second series, pp. 53–66.

The two last memoirs were originally read before the Academy of Science at Paris, on which a lengthy report was made, through a committee appointed for that purpose, consisting of Messrs. Cordier, Elie de Beaumont, and Dufrenoy, (director of the School of Mines.) The conclusions of the report were as follows:

"It results from the review just given of the labors of Dr. Smith that he has made known—

"1st. The precise nature of the geology of emery in Asia Minor and the Grecian Archipelago;

"2d. That he has described the properties of the principal minerals associated with it, and the manner in which they occur, especially diaspore and emerylite. This last mineral forms, by the identity of its composition in the different formations that the author had occasion to study, a mica constituting a new species and one well determined.

"3d. Finally, that he has given a means of determining the quality of emery, and consequently their commercial value. This process, eminently practical, offers, besides, an interest in a scientific point of view, inasmuch as it permits of the determination of the difference of the tenacity of minerals of equal hardness.

"These researches of geology, mineralogy, and of analytical chemistry, constitute a work of the highest interest, both as a
672 whole, as well as from the new facts they furnish to science. Your committee, consequently, propose to thank Dr. Smith for having communicated them to the Academy, and, in consideration of the importance of the work, to order its insertion in the Recueil des Memoires des Savants etrangers."

No. 8. Warwickite, a boretitanate of magnesia.—Am. Journal of Science, vol. 16, p. 293.

No. 9. Report on the minerals of Chili.—U. S. Astronomical Expedition to Chili.

No. 10. On the geological position of the meerschaum, near Eskisher, in Asia Minor.—Am. Journal of Science, vol. 7, second series, p. 286.

No. 11. Discovery of two new minerals from near Ephesus, in Asia Minor, called emerylite and ephesite.—Am. Journal of Science, vol. 7, second series, p. 285, and vol. 11, pp. 59–62; Annales des Mines, vol. 18, fourteenth series, pp. 294–300.

No. 12. Discovery of a new locality of liebigite.—Am. Journal of Science, vol. 11, second series, p. 257.

No. 13. Analysis of a magnesian opal.—Am. Journal of Science, vol. 5, p. 435.

No. 14. Analysis of the thermal waters of Asia Minor. Second part. Waters of Yalova, Hierapolis, Eskisher, Troy, Mitylene, and Tiberias. —Am. Journal of Science, vol. 12, pp. 366, 367.

RE-EXAMINATION OF AMERICAN MINERALS.

No. 15, part 1. Margarite, aragonite, bowenite, euphyllite, lancasterite, lazulite, mica of Litchfield, oligoclase, uniouite, williamsite.—Am. Journal of Science, vol. 15, pp. 209–215.

RE-EXAMINATION OF AMERICAN MINERALS.

No. 16, part 2. Chesterlite, loxoclase, Danbury feldspars, Haddam albite, Greenwood mica, biotite, margarodite, chesterlite talc, rhodophyllite, cummingtonite, hydrous anthophyllite, monrolite, ozarkite, dysyntribite, gibbsite, emerald nickel.—Am. Journal of Science. vol. 16, pp. 41–58.

RE-EXAMINATION OF AMERICAN MINERALS.

673 No. 17, part 3. Danburite, carrollite, thalite, hudsonite, jenkinsite, lazulite, kyanite, elœolite, spodumene, petalite.—Am. Jour. of Science, vol. 16, pp. 365–375.

RE-EXAMINATION OF AMERICAN MINERALS.

No. 18, part 4. Boltonite, iodid of silver, copiapite, owenite, xenotime, lanthanite, manganese alum, apophyllite, schreibersite, protosulphuret of iron, Cuban.—Am. Journal of Science, vol. 18, pp. 372–381.

RE-EXAMINATION OF AMERICAN MINERALS.

No. 19, part 5. Anglesite, cerusite, wulfenite, vanadate of lead, pyromorphite, mimetene, galena, copper, copper pyrites, malachite, aznrite, blende, calamine, hematite, fluor spar, calc spar, sulphur.—Am. Journal of Science, vol. 20, pp. 242–254.

No. 20. On the emery mine of Chester, Hampden County, Mass., with remarks on the nature of emery and its associate minerals.—Am. Journal of Science, vol. 42.

No. 21. New method of determining alkalies in minerals, part second. Conversion of sulphates into chlorides, quantitative determinating of mixed alkalies, separation of the alkaline chlorides, with a more direct method of obtaining them from silicates not soluble in acids.—Am. Journal of Science, vol. 16, pp. 53–61.

No. 22. Discovery of oxide of cobalt at Silver Bluff, South Carolina. —Am. Journal of Science, vol. 48, p. 103.

No. 23. Composition of marl from Ashley River, South Carolina, by which it is shown to contain much phosphate of lime, some ammonia and crenic acid.—Am. Journal of Science, vol. 48, pp. 101–103.

No. 24. Action of oxalic acid on the nitrates and chlorides of sodium and potassium and the reaction of its solution on zinc.—Am. Journal of Science, vol. 17, p. 373.

No. 25. Action of some of the alkaline salts upon the sulphate of lead. —Am. Journal of Science, vol. 47, pp. 81–84.

No. 26. The calcarimetre. A new instrument for estimating the quantity of carbonate of lime in marls and other calcarious substances.—Am. Journal of Science, vol. 46, pp. 262–266.

674 No. 27. A method of getting rid of sal ammoniac in analysis.—Am. Journal of Science, vol. 15, p. 90.

No. 28. Description of five new meteoric irons, with some theoretical considerations connected with meteorites. In two parts.—Am. Journal of Science, vol. 19, pp. 152–163, 323–343.

No. 29. Account of meteoric stones that fell in Harrison County, Indiana, March, 1859, with composition of the same.—Am. Journal of Science, vol. 28, pp. 409–411.

No. 30. Description of three meteoric irons, from Nelson County, Ky., Marshall County, Ky., and Madison County, N. C.—Am. Journal of Science, vol. 30, p. 240.

No 31. Report on phenomena attending the fall of the Guernsey County, Ohio, meteoric stones, 1860, with analysis of the same.—Am. Journal of Science, vol. 31, pp. 87–98.

No. 32. Description of three new meteorites: Lincoln County, Tenn., meteoric stones that fell August, 1855; Oldham County, Ky., meteoric iron; Robertson County, Tenn., meteoric iron.—Am. Journal of Science, vol. 3.

No. 33. A new meteoric iron, from Wayne County, Ohio. Some remarks on the recently described meteorite from Atacama, Chili.—Am. Journal of Science, vol. 38.

No. 34. A new meteorite from Newton County, Arkansas, containing on its surface carbonate of lime.—Am. Journal of Science, vol. 40.

No. 35. A new meteoric iron from Colorado Territory.—Am. Journal of Science, vol. 43.

No. 36. Chladnite of the Bishopville meteoric stone proved to be a magnesian pyroxene.—Am. Journal of Science, vol. 38.

No. 37. On chromate of potash as a reagent for distinguishing between the salts of baryta and strontia.—Am. Journal of Science, vol. 36, pp 138–148.

No. 38. On the means of detecting arsenic in the animal economy and of counteracting its effects. First part.—Am. Journal of Science, vol. 60, pp. 278–293.

No. 39. On the means of detecting arsenic in the animal economy and of counteracting its effects. Second part.—Am. Journal of Science, vol. 42, pp. 75–81.

675 No. 40. On the action of potash upon cholosterine.—Am. Journal of Science, vol. 44, pp. 60–63.

No. 41. On the composition of spermaceti, and the products of its distillation, with some remarks on its decomposition by nitric acid; resulting in a complete change of the chemical history of spermaceti, and adopted by Berzelius in the sixth volume of his last edition of Chemistry.—Annalen der Chemie und Pharmacie, 1842; Annales de Chmie et de Physique, 1842; Am. Journal of Science, vol. 43, pp. 301320.

No. 42. Action of nitric acid on the chlorides of sodium and potassium.—Am. Journal of Science, vol. 16, p. 373.

No. 43. Analysis of the cotton-plant and forty varieties of cotton-soils, with some remarks on the nature of rust in cotton.—Southern Agriculturist for 1846.

No. 44. The discovery of sulphate of iron and of alum in rice-fields soils, and the indirect effects of drought on rice-lands, with the manner of counteracting its effects.—Southern Agriculturist for 1846.

No. 45. Action of the solution of the neutral phosphates of the alkalies upon carbonate of lime and some other insoluble carbonates.—Am. Journal of Science, vol. 48, pp. 97–98.

No. 46. A new method of making permanent artificial magnets by galvanism.—Am. Journal of Science, vol. 36, pp. 336–337.

No. 47. A new method of freezing water under the receiver of an air-pump, without the aid of sulphuric acid or other desiccating agent—Am. Jour. of Science, vol. 1, second series, p. 265; Southern Journal of Med. and Pharmacy for 1846.

No. 48. Report on Dupont's artesian well, at Louisville.—Am. Journal of Science, vol. 27, pp. 184–278.

No. 46. The inverted microscope, (a new form of microscope,) with the description of a new eye-piece micrometer, and a new form of goniometer for measuring the angles of crystals under the microscope.—Proc. Société de Biologie at Paris, 1850; Proc. of the Am. Scientific Association, 1851; Am. Journal of Science, vol. 14, second series pp. 233–241.

676 Q. 5. Are you acquainted with the various processes empoyed heretofore and at present, in the manufacture of fatty acids and glycerine, and for preparing fats for manufacture into candles; and if you are acquainted with such processes, please state your source of information, whether you are both theoretically and practicaly acquainted therewith, and whether or not your attention has bee specifically directed to such branch of chemical industry?

A. I consider myself familiar with the processes that have been and are now employed for the manufacture of fatty acids and glycerine for the various purposes to which they are applied in the arts.

My sources of information in such branches of industrial chemistry have been from my studies in the laboratories of distinguishedchemists and manufacturers who have devoted their attention to ths subject, such as Liebig and Pelouze, of Germany and France; als from the careful study of the labors of Chevreul in France, and fron my observations in the great candle-factories of Price and Company n Battersea, near London, and in the original star-candle factory of DeMilly, on the barrière de l'Etoile, in Paris; in this last candle-factow the practical knowledge I obtained has been most thorough and complete, through the kindness of my personal friend DeMilly, the founder and owner of the establishment. My attention has been for a period of years directed to this branch of industry.

Q. 6. Have you filled any position as committee to investigate and report upon this branch of industrial chemistry, under appointment from any scientific body? If yea, please state what appointment you have so filled, and whether you have made any report under the same.

A. In 1867, I was appointed by the general council of the Paris exposition (of which I was a member, and at the same time vice-president of the jury of the chemical department) to make a report for he imperial commission of said exposition, on the fatty acids and candes then exhibited, together with a full report on the progress of this

branch of industry in the world, since 1862. I was also appointed by the American commission to said exposition to make a more extended report on the same subject in connection with industrial chemistry, at that time; the report for the imperial commission has been pub-
677 lished in the sixth volume of their reports, that for the American commission is now in course of publication.

Q. 7. Will you please describe the different processes that have been and are now employed for the decomposition of fats, and the production therefrom of fatty acids, or fatty acids and glycerine?

A. There have been a variety of processes for the decomposition of fats into acids and glycerine. In some, the acids alone being sought after, and in others, both the acids and glycerine are recovered. The processes applied in manufactural chemistry, and known under the general term of saponification of the fats have been: First, by decomposition of the fats with alkalies, alkaline earths, and other bases in conjunction with water and heat, either in open vessels or under pressure. This was first applied in 1825, by Chevreul and Gay-Lussac, and has been subjected to various modifications since. Secondly, by heating the fats and distilling the same over a naked fire without the presence of water, as found in the specifications of Moses Poole, in 1825, to be found in Stas' reports on stearic acid, made in the exposition report at Paris, 1855. Thirdly, by heating the fats to a high temperature, and passing superheated steam through them first sketched out in 1825, by Chevreul and Gay-Lussac, and afterward carried out with various improvements and modifications in France and England, especially by E. Price and Company in 1842, Scharling in 1850, and finally by George Wilson and Payne in 1854. Fourthly, by heating the fats with sulphuric acids, (containing two equivalents of water,) and by subsequent distillation, the fat acids are obtained and the glycerine destroyed. It has been carried on successfully and extensively since about 1846. Fifthly, by heating the fats to a high temperature in contact with water in close vessels, first noticed by Farad'y, in 1823, as taking place in Perkins' engine, and subsequently applied practically by R. A. Tilghman, in the United States, and a little later by Melsens, in Belgium; by this process both the fat acids and glycerine are obtained. Sixthly, by heating the fats to a high temperature in contact with a small quantity of lime and water in a close vessel into which superheated steam is passed, first marked out by Gay-Lussac, in his original patent,
678 in 1825, and made practical by DeMilly, in 1855, and practiced more or less extensively in various parts of the world; in this both the fat acids and glycerine are obtained. Seventhly, saponification by heating with sulphuric acid (containing two equivalents of water) for a very short period of time under peculiar circumstances, by which the fat acids procured are at once subjected to pressure without previous distillation; this is a recent invention of De Milly, having, as yet, but limited application.

I might mention yet other proposed processes of saponification of fats for candle purposes, but as they never received any technical application it is useless to refer to them. Of the above methods, those employed in practice are, first, the lime saponification; second, sulphuric acid saponification; third, saponification in closed vessels, at a very high heat, with water; fourth, saponification in closed vessels with high heat, lime, and water; all four of which methods are distinct in their character, each having its merits and demerits.

Q. 8. Have you read, and do you understand the letters-patent issued to the complainant herein, Richard A. Tilghman, bearing date October 3d, 1854, and numbered 11776?

A. I have read the letters-patent and think I understand them.

Q. 9. Have you read, and do you understand, the original application of Richard A. Tilghman for said letters-patent as obtained in the official certified copy of such application?

A. I have read the certified copy, and think I understand that.

Q. 10. Have you read the descriptions of the processes of the defendants, as set forth in their original and supplemental answers in this suit; and do you understand the nature of the processes so described?

A. Yes, I have read the descriptions, and believe that I understand them fully.

Q. 11. Have you seen and examined defendants' processes, as practically carried on?

A. I have seen and examined such processes as practically carried on in the factory of Messrs. Werk & Co., at Cincinnati; also, I have seen a similar process, as practiced in the candle-factory of DeMilly, at Paris.

Q. 15. Having read and understanding, as you state, the complainant's letters-patent, and understanding also, as you state, the pro-
679 cess of the defendants as described in their original and supplemental answers; will you please state whether or not, in your opinion, the said processes of the defendants are, or is either of them, substantially the same in principle, mode of operation, and results produced, as the process described in the complainant's said patent; and in expressing your opinion in answer hereto, will you please mention any facts which you may have observed and describe any experiments which you may have conducted from which the opinion which you have formed, and may express, is derived.

A. In answering this question it will require a review of the entire subject as I have investigated it, and will be quite lengthy, for I am not able to curtail it.

R. A. Tilghman, in his letters-patent, describes a process for producing from fatty bodies free fat acids and a solution of glycerine by subjecting said fatty bodies to the action of a high temperature and pressure in the presence of water; that temperature is embraced within certain limits, namely: from the melting-point of tin (440° Fa'r.) to the melting-point of nitre, (660° Fa'r.,) which temperature is further explained in the original application for letters-patent by the complainant in relation to forming soap by heating fats with the carbonate of the alkali, (which application I have carefully read,) where he states "that the degree of heat required is less than that which is necessary to produce fat acids, and should generally be kept between the melting-points of tin and bismuth, (440° Fa'r. and 510° Fa'r.) At about 350° Fa'r. the neutral fats will form soaps with the alkaline carbonates, but a higher temperature will produce the result more quickly." Still further in the letters-patent originally referred to, the complainant states: "the melting-point of lead has been mentioned as the proper heat to be used in the operation, because it has been found to give good results, but the change of fatty matter into fat acids and glycerine takes place with some materials (such as palm oil) at or below the melting-point of bismuth, (510° Fa'r.,) etc." And furthermore in the patent of the complainant it is stated that the mixture of fat and water should be exposed to the desired temperature for ten minutes.

So, then, the first point of difference which I observe between the processes of the complainant and defendants is the great difference in
680 the temperature at which the decomposition is effected in the

two cases; in the complainant's case the temperature ranging from 440 to 660 deg. Fa'r., and in the defendants' process about 320° Fa'r.; and, secondly, the relative time required by each process; the complainant's process requiring ten minutes, and the defendants' process eight hours. The third point of difference in the two processes is the difference in the character of the vessels required; the complainant requiring vessels of immense strength, for he speaks of testing them by way of precaution with 10,000 pounds pressure to the square inch, while the "working pressure" "will not be found to exceed 2,000 pounds to the square inch," while the defendants' vessels are of the strength of the ordinary boiler, in fact, the boilers furnishing both steam and pressure being a battery of ordinary boilers; such vessels as are used by the defendants would be worse than useless in carrying out the specifications of complainant's patent. Fourth point of difference is in the agents employed by the complainant and by the defendents; the former using great heat and liquid water only; the defendants using a moderately high temperature, lime, water, and steam, these agents acting in conjunction in bringing about the final result, namely, the complete decomposition of the fats. As regards the respective part that each plays, I do not believe that any chemist can give a reliable explanation in our present state of knowledge. The late distinguished French chemist, Pelouze, in some researches, made in 1855, on this subject, namely, the decomposition of the fats by a small quantity of an alkali or other base under pressure, aided by heat and water, attributes the decomposition to the base only. Other chemists attribute the decomposing action to the steam to a considerable extent; others to the heat, and others to the liquid water. I myself, from experiment and reflection, consider that the heat has a more powerful decomposing action than any other agent employed in the defendants' process, except it be the lime, and what I here state, with reference to the powerful decomposing action of heat alone, has much to do with what takes place in the complainant's process. In what I state with reference to the decomposing power of heat, I would be understood to mean that heat is the only agent, when employed alone, that can accomplish a nearly complete decomposition of the fats. Lime and sulphuric acid will do it without heat, but only to a very limited extent, and after a prolonged
681 action; while pure water alone without heat has no action upon the fats, except it may be to an exceedingly small extent. But the safest theoretical deduction for any chemist to make is that these different agents aid one another in some manner or other, for no one of them alone can produce what their combined action accomplishes. As regards what action the water has in the defendants' processes, as this substance, water, is to be found in those processes both as a liquid and as steam, (the last constantly bubbling through and agitating the whole mass,) I should certainly attribute whatever action the water may have almost, if not exclusively, to that substance in the form of steam; especially so when sustained by the experiments of Scharling, in 1850, and George Wilson and Payne, in 1854. Besides, steam is a more favorable form for water to produce chemical action, and we know that the acids and glycerine do not exist ready formed in the fats as we find them when separated, it requiring the elements of the water to form free fat acids and glycerine; and, from the time soaps were first formed to the present day, water had to be present in some form or other whether saponification was produced by potash, lime, acid, or heated steam, and the more finely divided the particles of water the more readily would they combine with the fats when the other requisites of

saponification were brought to bear upon the fats. As regards my theoretical opinion of the operation in the defendants' processes, (where lime is used in quantities insufficient to produce a neutral soap with the fat acids,) I had not ventured to form any, and am deterred for the present from putting my name to any theory, familiar as I am with the great theoretical blunders made by chemists upon some of the commonest chemical arts, as, for instance, Le Blanc's process for making soda. Although the process is fully eighty years old, it has had many theoretical explanations by the ablest chemists which have been successively set aside, and it is now considered that the theory of Kopp, made but two or three years ago, is doubtless nearer the truth than any other; and what is true of the art of making soda from common salt is true of many other manufactural processes. But of one thing I am, at present, convinced, after numerous experiments in my own laboratory and careful scrutiny of the defendants' operation, as conducted in the factories of De Milly, in France, and defendants, in Cincinnati,
682 namely, that in no stage of the process is the lime without action, either at the commencement of the operation when the lime is uncombined, or in the middle, or in the end of the operation after the lime has formed a soap with the fat acids. One fact I may state in this connection. I had introduced into the large digester, in the factory of the defendants, the usual amount of fat for one charge, six thousand pounds, and four hundred and eighty gallons of water, but used no lime; the other conditions remained the same as those employed by the defendants in their operations with the lime. I examined the boilers, pressure-gauges, safety-valves on the digester, the pressure and the heat employed, visiting the digester and boilers every half hour, continually watching it for eight hours; the temperature in the digester corresponded to a pressure of about 70 pounds, a temperature under 320° Fa'r. The pressure in the boiler, as indicated by one of Ashcroft's steam-gauges recently inspected by Miles Greenwood, indicated 82 pounds pressure. The valve of the digester, which I have stated indicated a pressure of about 70 pounds, was constantly blowing off immense quantities of steam, so much so as to make it necesssry for me to approach within 12 inches of the valve-lever in my frequent inspections of the same during the operation. I would state that I had the safety-valve detached, measured it myself, measured the length of the lever-weight attached to same, so that I might know positively the temperature and pressure from personal knowledge. At different stages of the process, during the eight hours, I drew off samples for examination that were subsequently analyzed by me in my laboratory. The free fat acid found in the specimens was small; the largest amount was that contained in the mass after eight hours' action, this amounting to a little over ten per cent. of the original fat, thus leaving nine-tenths of the fat unaltered; so that at the temperature that defendants operate with it would require eight hours to decompose the entire mass without lime. Now, when the defendants' use enough lime to form a neutral soap, with only four-tenths of the fat, the other six-tenths are yet completely changed into fat acids and glycerine in seven or eight hours, which could not be the case if, as some assume, the lime exerts no further action in the operation when once it has formed a neutral soap; for, according to this view of the subject, it would require with the
683 four per cent. of lime forty-eight hours for complete saponification, while, in fact, it is all accomplished in eight hours. All of which goes to prove that the lime exerts an influence upon the entire mass of fat, even to the end of the operation; and in this opinion I am

sustained by Professor Rogers, one of the complainant's witnesses in this suit when responding to certain statements of Mr. Ropes analogous to the statements I have just made. Professor Rogers says, in answer to cross-question 100, "I infer, assuming the correctness of Ropes' statements, that the small quantity of lime exerts an influence which ends in the conversion of the entire mass of fat and acids, the result which is obtained upon the whole mass."

My experiments on this subject were numerous, and made in two vessels that I had constructed for the purpose, and whenever I desired to compare two different processes, these vessels were used simultaneously and placed together in a properly arranged heater to keep the two vessels at the same temperature for any given length of time, they being frequently agitated in such manner as not to interfere with their being kept at uniform temperature.

I will refer to but two or three of these experiments: Vessel number 1 contained water and fat, with a space above them in which steam could collect; number 2 contained water, fat, a space for steam, and a small quantity of neutral lime-soap previously prepared, chemically pure. The vessels were elongated cylinders of gun-metal, one fourth of an inch in thickness, about seven inches in length, and an inch and a quarther inside diameter, with strong flange at the open end, that was closed with a thick plate of gun-metal, fastened down by a powerful cross-head screw, with a gasket of thin lead between the cover and cylinder; the vessels were heated in a large bath of parafine by the aid of a gas-burner, and agitated by a spring bow overhead when required; the agitation was made once an hour for 20 or 30 seconds at each time, the tubes being vertical. The materials experimented with were introduced into the cylinder directly, or in glass tubes that were placed in the copper cylinder; the vessels, Nos. 1 and 2, with their contents referred to above, were exposed to a temperature of 320° Fa'r., for eight hours; after which they were opened, the contents of the vessel No. 1 was decomposed only to the extent of one-tenth of the fat, while in ves-
684 sel No. 2, where I used a little neutral lime-soap, there was but a trace of undecomposed fat. In another set of experiments using in No. 2 four per cent. of lime, No. 1 having only water and fat, the amount of fat acids liberated ranged from ten to thirteen per cent., while the decomposition in No. 2 was what would be practically called complete. These and several other experiments are perfectly in accord with those made by Pelouze, and referred to by him in his remarks "On the saponification of fatty bodies by the soaps," and communicated by him to the Academy of Sciences of Paris, December, 1855; they also agree with the observations made by Stas in 1855, in the factory of DeMilly, and recorded in his report on the chemical products of the exposition at Paris, in 1855, and with my own observations in the same factory in 1867.

To sum up in a few words my opinion of the processes of complainant and defendants, I would state—

First. That each process is based on facts observed many years ago, by one or more individuals, however new they may be to either of the parties to this suit.

Secondly. That the materials and agents employed by them, respectively, constitute them two distinct and dissimilar processes.

Thirdly. That in the temperatures and time required, and nature and strength of vessels employed in the two processes respectively, there is a wide difference.

Fourthly. As to the nature and sequence of chemical changes in the

processes of the complainant and defendants, while they are surrounded with a degree of obscurity that should make chemists cautious in too positive assertions of their theoretical deductions, yet there is sufficient light thrown on the subject by my own experiments, and those of distinguished chemists, to sustain me in the conclusion that the complainant's and defendants' processes are dissimilar, both theoretically and practically.

Here adjourned until Wednesday, June 23d, 1869, at 10 a. m.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

685 Met pursuant to adjournment.

Q. 13. What method of analysis did you submit the products of your experiments to, in order to ascertain the relative percentage of free fat acids produced, and of undecomposed fat?

A. In analyzing the products of decomposition in my experiments, I proceeded as follows: I heated material to be analyzed in a glass flask, with about 20 to 30 times as much water as there was fat employed; the water was brought to a temperature of about 150° Fa'r., and then a very thin milk of lime was added, in very small portions at a time, to the heated water and fat, agitating thoroughly after each addition. There was an excess of milk of lime added over and above what would be required to combine with all the acids of the fat. After thorough agitation, the water was allowed to cool to the ordinary temperature and thrown upon a filter; the water passed through, leaving on the filter the lime-soap, the excess of lime, and some fat, if all of this last had not been decomposed, (some of the undecomposed fat sticks to the inside of the flask;) the filter was laid aside with its contents, on several thicknesses of filter paper, and left to dry in the temperature of the surrounding air. This required usually from two to four days. I next used as a solvent pure redistilled benzole; this was added to the flask in sufficient quantity, say, from ten to twenty times the amount of fat used, and gently warmed to about 120°; this solution was poured into a glass beaker, and the flask washed out once or twice with a little more benzole, which was added to the first portion. A little lime-soap was often found adhering to the vessel, but came out with the benzole solution in a state of suspension. The benzole solution was set aside, when the little lime-soap it contained settled, out from which the benzole solution was decanted, and the lime-soap further washed by the same process. I next proceeded to treat the dried contents of the filter with benzole in the same manner, and by repeated washing and settling the lime-soap was purified. Finally all the benzole solutions of the first and second part of the operation was heated, the benzole being driven off, and the undecomposed fat remaining behind; the lime-soap which was not dissolved by the benzole was thrown on a filter, and after the little benzole remaining in it passed through the filter, the filter and its contents
686 was dried in the air, (which desiccation is accomplished in a few hours;) the dry lime-soap was then moistened with alcohol and decomposed with water and hydrochloric acid, heated to about 212° Fa'r.; the free fat acids now rose to the surface, and after the whole was cooled down to 50 or 60° Fa'r., the fat acids were collected from the surface of the liquid and weighed. Of course this process was modified according to the nature of the analysis required to be made, which modification was such as would suggest itself to any analytical chemist. The milk of lime was added to combine with any pre-existing free fat acids in the compounds under analysis, and the milk of lime thus added, at about 150°

Fa'r., has no sensible chemical action in decomposing the fats, except after long-continued action.

Q. 14. Does the apparatus or digester of the defendants bear any resemblance to the tube or coil apparatus described in complainant's patent and shown in the drawings annexed thereto?

A. It does not.

Q. 15. Would such coil-apparatus be a suitable form of apparatus in which to carry on, practically, the process of the defendants?

A. It would not.

Q. 16. In the letters-patent of the complainant, another kind of apparatus, aside from the coil-apparatus, is contemplated, and is referred to in the following words as contained in said patent, to wit: "I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting-point of lead, until the operation is complete. The vessel must be closed and of great strength so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam." Is the apparatus or digester of the defendants such a "convenient vessel" as described in the complainant's patent; and could the conditions as specified in said patent relative to such "convenient vessel" exist in the apparatus of the defendants?

A. The apparatus of the defendants is not such a convenient apparatus as described in the letters-patent; the conditions could not be realized in defendants' apparatus, it being of a strength not exceeding that required for the pressure that ordinary steam-boilers have to
687 sustain. Whereas, any apparatus, to accomplish the results as set forth in the letters-patent, would be required to be of enormous strength, surpassing that of any steam-vessel in ordinary use.

Q. 17. Could a vessel of the diameter and size of the defendants' digester, be employed under the conditions specified in the complainant's patent?

A. It most certainly could not. The digester, however strong it might be, is but a part of the apparatus of which the boilers are a part, the boiler and the digester being in free communication, one with another, the strength of the apparatus cannot be measured by any other rule than that the weakest point of a vessel under pressure, is the true measure of the strength of said vessel, and I suppose that no boiler-inspector would rate the boilers in defendants' works, beyond 120 to 140 pounds safe pressure.

Q. 18. Could a vessel or digester of the diameter of that employed by the defendants be constructed so as to answer the requirements of the "convenient vessel" described in complainant's patent, even though the heat applied to it was by extraneous fire, and not communicated from separate steam-boilers?

A. Certainly it could, by making it of wrought iron, a number of inches in thickness.

Q. 19. And what do you say as to the practicability thereof?

A. I would say that it was a very impracticable, but not an impossible thing.

Cross-examination by B. C. Tilghman, esq., attorney for complainant.

X Q. 20. Were not most of the questions which have been asked you by the counsel for the complainant, prepared in writing and submitted to you prior to commencing the taking of your deposition in this case?

A. When I came to Cincinnati, on Monday, June 21st, I had neither questions suggested nor answers prepared. The substance of my in-

vestigation and experiments were fully made out in writing, and a short while before giving my evidence the counsel for the defendants was made acquainted by me with the facts and statements I had pre-
688 pared to submit in evidence, upon which the defendants' counsel propounded the questions.

X Q. 21. How long a time have you been engaged in making investigations and experiments in this present suit?

A. About two months.

X Q. 22. As a technical and scientific chemist, do you not consider that the most reliable and satisfactory method of giving testimony as to scientific questions, is to prepare the answers deliberately, and in writing?

A. It certainly is to the chemist.

X Q. 23. Was the method of analysis described in your 13th answer-in-chief, that which was introduced by the French chemist, Berthelot, in his investigation of fatty substances?

A. The method of analysis was marked out by myself in all its details, and carried into effect, when it occurred to me that Berthelot had employed a method somewhat similar, but so satisfied was I with the results obtained in the method pursued by me, that I gave myself no further thought on the subject, not caring whether the method was new or old, so long as it gave me, as I believed, accurate results.

X Q. 24. Does not the accuracy of the method of analysis used by you, depend*ed* entirely upon the insolubility of the lime-soaps in benzole?

A. It does.

X Q. 25. Is benzole the same substance as that which is called benzine by the French chemists?

A. The benzole I used was the light volatile hydro-carbon distilled from petroleum oil, and boiling at a temperature of about from 130 to 160° Fa'r.; the benzole from coal tar is a different product from the one used in my experiments, but I believe would answer quite as well. The benzole employed was carefully rectified by me in my laboratory.

X Q. 26. About how much benzole did you use in dissolving and washing your fatty substance, in proportion to the weight of said fatty substance?

A. From about 30 to 35 parts; the first treatment consuming proportionally the largest amount; for when once the bulk of fats soluble in benzole was removed, the further washing required very small additions each time.

X Q. 27. From your examination of the product of defendants'
689 process (prepared with four per cent. of lime, as described in their supplementary answer,) it consists of about 40 per cent. of lime-soap, and about 60 per cent. of free fat acids, does it not?

A. The mixture in the defendants' process consisted of 4 parts of lime and about 100 parts of fat acids, less the amount of glycerine contained in the fat originally used; the original materials employed being 100 parts of neutral fat and 4 parts of lime.

X Q. 28. How many parts of said fat acid (if any) were saturated, or neutralized by the 4 parts of lime?

A. To make what is called a neutral lime-soap with the 4 parts of lime employed, it would require about 40 parts of fat acid; there were 40 parts of fat acid found in the lime-soap separated by my process of analysis. By this, however, I do not mean to assert that the product as it came from the digester contained the lime, in the condition of a neutral lime-soap.

X Q. 29. In what chemical condition were the remaining 60 parts of

said fat acids existing in defendants' product as it came from their digester?

A. I cannot state the exact condition in which this fat acid existed at the time it was taken from the digester.

X Q. 30. Then you are not able to say at present whether or not the defendants' product, as it came from the digester, contained any free fat acids whatever; is that so?

A. In my opinion there is more or less free fat acid produced in this method of saponification by a small quantity of lime. How much of it is in that condition, neither I, nor, as I believe, any other chemist is capable of determining at the present time.

X Q. 31. From all your knowledge and investigations on the subject, are you able at present to state whether or not defendants' product, as it comes from their digester, contains any neutral lime-soap?

A. I am not.

X Q. 32. To the best of your knowledge and belief, as a chemist, does not defendants' product, as it comes from their digester, consist substantially of a mixture of free fat acids and neutral lime-soap?

690 A. I have just stated in the two previous answers, what might be considered as a full answer to this question; for, as in Answer No. 30, I stated that I believe it impossible for any one to assert how much of the acid was free acid; and, consequently, no one could say how much neutral lime-soap there was. Of course, I have to reiterate my answers given to those questions, namely, that I cannot tell.

X Q. 33. Are you prepared to testify, that defendants' product, as it comes from their digester, is not a mixture of free fat acids and neutral lime-soap?

A. I am prepared to testify that there is no evidence of defendants' product being a mere mixture of neutral lime-soap and free fat acid. Simply from the fact of obtaining these substances (free fat acids and lime-soap) by analysis, is no evidence that these substances existed precisely in such conditions previous to subjecting them to the analytical process. The history of analytical chemistry, both past and as it is now conducted every day, sustains me in this view of the subject; for even such compounds as mineral waters, that are analyzed every day by the very best chemists, do not, by their own admission, furnish evidence of the exact manner in which the various ingredients exist in the original mineral water. I might further adduce the evidence of Chevreul, on the very class of bodies (fats) under consideration, showing that the very nature of the solvents brought to bear upon soaps, determine the nature of ingredients found in solution, and in the insoluble parts. He shows clearly that, in using water, alcohol, and ether, treating the same soap with these three different liquids, they give rise to different decompositions of this soap. (See Chevreul "Reserches sur les corps gras," page 36, paragraph 72; page 418, paragraph 1144, commencing at 8th line from the bottom of the page; page 49, paragragh 1145.) I might instance many other analogous facts in analytical chemistry, did I not believe that what has already been stated bears me out in the statement made in the first part of this answer. With these facts staring me in the face, I am not fully prepared to testify that defendants' product is not such as contemplated in the question, to wit, a mixture of neutral lime-soap and free fat acids; while from my examination of the subject, and the recorded facts of others, I am strongly inclined to the belief that it is not a mixture of free fat acids and neutral lime-soap.

X Q. 34. State particularly, and in detail, the chemical properties in which defendants' said product differs from a mixture of neutral lime-soap and free fat acids?

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A. The question in reference to a chemical difference has never been determined; a physical difference between the two, or rather between a fat saponified by a limited quantity of lime and a mixture of free fat acids, through which neutral stearate of lime has been diffused, is that the former is transparent or translucent, the latter opaque with the neutral lime-soap diffused through it.

X Q. 35. Do I understand you to say that you cannot point out any chemical properties in which defendants' said product differs from a mixture of neutral lime-soap and free fat acids?

A. I do say so, and in this there is nothing remarkable, for we have many compounds, with two or more equivalents of acids combined chemically, that we cannot point out any marked chemical difference, to show that they are not mere neutral salts mechanically mixed with free acid. For example: In Gmelin's Chemistry, and other treatises on the same subject by different authors, we have under one of their headings "Acid carbonate of lime," a compound which no one has ever seen, but is admitted by all chemists to exist in solution, notwithstanding they cannot prove that it is not but a mere mixture of carbonic acid and carbonate of lime; and the same may be said to be true of even the bicarbonates of soda and potash when they are in solution; these two last being only recognizable as distinct acid salts when in their solid forms. I might cite other instances where other acids are to be found that would bear me out in this.

X Q. 36. Does not defendants' said product resemble a mixture of neutral lime-soap and free fat acids in the following chemical property, to wit, that when both are treated with alcohol, and the solution filtered and evaporated, a large quantity of free fat acid is obtained from the alcohol, while a quantity of neutral lime-soap is left on the filter?

A. It does resemble a mixture in that chemical property, but that in no way proves the identity of the two compounds, no more than the fact of taking, on the one part, a solution of carbonate of soda, and on the other part, a solution of bicarbonate of soda, and evaporating these two solutions to dryness, and finding as the results of both evapo-

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rations, carbonate of soda, would lead to the conclusion that therefore carbonate of soda and bicarbonate of soda were the same thing.

X Q. 37. In the example you have just given, could not any chemist easily collect the carbonic acid given off during the evaporation of the solution of the bicarbonate spoken of, and thus prove an essential and radical chemical difference between the two substances?

A. Of course by this second chemical operation, any chemist would be able to establish this fact, but this presupposes a second operation, and the employment of additional means of arriving at said end; namely, the facility that chemists have of collecting and recognizing gases; and this example was cited by me, to prove that merely one operation might deceive any chemist in making proper deductions upon the nature of supposed mixtures, or compounds. And did not chemists have the means of manipulating gases, of course they could recognize no difference in the carbonate tested in the way above referred to.

X Q. 38. Can you by any second chemical operation, or any number of chemical operations, or by the employment of any additional means or apparatus, point out any difference between the chemical properties of defendants' said product, and the chemical properties of a mixture

of neutral lime-soap and free fat acids, as described in cross question No. 36?

(Counsel for defendants objects to the further pursuit of this line of examination, for the following reasons: First, because the same is not cross-examination; second, because the same is irrelevant and an unnecessary encumbering of the record, inasmuch as the question involved in this suit, is not as to the character or nature of the products of defendants' process, but whether or not such products (be they one thing or another) are produced by the agent claimed in the complainant's letters-patent, to wit, water at high temperature and pressure.)

A. No. I cannot by any chemical means, point out this difference. But in this there is nothing at all surprising, especially in questions where organic chemistry are involved; in support of which I might cite facts enough to fill many pages. I will barely allude to one in relation to two well known substances, oil of turpentine and oil of orange, between which there is no way of pointing out any chemical differ-
693 ence, their differences being recognized by what are called physical properties, as odor, etc.

Here adjourned, until 10 A. M., Thursday, June 24th, 1869.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

Met pursuant to adjournment.

(In response to the objection just made, complainant's counsel asks whether defendants' counsel is willing to admit on the record, that defendant's product consists of a mixture of neutral lime-soap and free fat acids. If so, no further time will be spent on this point.

To the inquiry of the counsel for complainant, the counsel for defendants states, that he is not willing to make any admission whatever, as to the character of the defendants' product, whether it be a mixture of free fat acids and neutral lime-soap, or of free fat acids and basic-soap, or a product different from either of them; for the reason that he does not know the chemical nature of that product, and with'olds any expression of opinion as to it, until he shall have heard all the testimony in this cause. But he still insists that the question involved in this suit is simply whether the product of the defendants (be it one thing or another) is produced by the sole agency of highly-heated water under pressure; and he claims that the defendants have a right, irrespective of the complainant's patent, and without infringement thereof, to produce free fat acids and solution of glycerine, if such production is the result of the combined energy of water, steam, lime, and heat.)

X Q. 39. Apart from the refinements of chemical theory, and using the ordinary language of manufacturers, is not an acid which is not neutralized or saturated by a base, considered, and spoken of, as a free acid?

A. In order to be able to respond to this question, I must know what the complainant's counsel means by an acid "neutralized or saturated by a base."

(Complainant's counsel informs the witness that the phrase
694 "neutralized or saturated by a base," is used in the ordinary sense in which those terms are generally used and understood by practical chemists.)

A. The witness would state, that if he means by the neutralized or saturated combining with its equivalent of base, so that it has neither acid nor basic reaction, I am prepared to answer the question. As I

can obtain no explanation from the complainant's counsel, with reference to what he means by Cross-question No. 39, I proceed at once to answer the question, as I understand it. The question being for me to state, whether or not, an acid which is not "neutralized or saturated by base," is considered and spoken of as a free acid; my answer to this is, most certainly not; and if it were so, I would have to relearn all my chemistry. To establish what I here state, I will allude to one or two well-known compounds in the arts: First, acid or bichromate of potash; I am yet to learn the first chemist or technologist, who considers said bichromate of potash a compound of chromate of potash, and a free acid. Secondly, there is a well-known compound made in the arts, by the action of sulphuric acid upon nitre in the manufacture of nitric acid. This compound is never considered or spoken of as sulphate of potash, and a free acid, that being called the bisulphate of potash. The same is equally true of these compounds of carbonic acid and the alkalies, where the acid is not saturated or neutralized, commonly known as bicarbonates. No chemist or technologist ever speaks of these bicarbonates as composed of neutral carbonate containing a free acid. I might go on increasing the list of similar compounds, but the examples given are sufficient to establish the correctness of my first statement.

X Q. 40. In the cases you have cited (bichromate, bisulphate, and bicarbonate of potash) are not the quantities of acid and base in certain definite proportions?

A. Yes, they are, but their composition does not militate against the force and accuracy of my last answer.

X Q. 41. Are not the substances above cited by you all capable of being obtained in a separate and isolated condition?

A. They are; but I must again reiterate that this in no way militates against or alters the force and correctness of my answer to Cross-question No. 39.

695 X Q. 42. Are not the substances you have cited all recognized and described in standard chemical works, as distinct chemical compounds?

A. They are, as everything else in chemistry is recognized as a chemical compound; yet I must again state, that this answer, as well as the answers to Cross-questions Nos. 40 and 41, in no way conflicts with the point I wish to establish in answer to Cross-question No. 39.

X Q. 43. Please explain what is meant by the term free acid, as used by practical chemists.

A. Acid that is uncombined in any definite proportion with a base and does not form what may be called neutral compounds, or bisalts, or tersalts, or quadrosalts, etc., the last three of which contain two of acid to one of base, three of acid to one of base, and four of acid to one of base, etc.

X Q. 44. How many definite compounds of lime and stearic acid are known and recognised by chemists?

A. There has been, up to the present time, but one definite compound of lime and fat acids that has been noticed by chemists; but from the analogous compounds of fat acids and the alkaline bases, it is not unreasonable to conclude that there may be two or more.

X Q. 45. In that single compound of lime and stearic acid, now known and recognized by chemists, in what definite proportions are the lime and the stearic acid respectively contained?

A. One equivalent of each, corresponding to 9.82 pounds stearic acid to one pound of lime.

X Q. 46. According to your definition given in answer to Cross-question No. 43, that "acid that is uncombined in any definite proportion with a base" is free acid, then any stearic acid existing in a mixture with lime, beyond or in addition to the only definite proportion known (9.82 stearic acid to one lime) would be generally recognized by chemists to be free stearic acid, would it not?

A. I can only answer by placing chemists in the same condition as myself, after having made the same investigations, analyses, and researches as myself. Assuming this, then, with reference to other
696 chemists, I can only suppose they would form the same conclusion as myself, as is the case with the distinguished French chemist, Pelouze, and others, namely, that this lime compound may be more or less, or altogether, an acid lime-soap.

X Q. 47. Then there are other lime-soaps or definite compounds of stearic acid and lime, besides the one mentioned by you in answer to Questions Nos. 44 and 45, as the only one generally known and recognized by chemists? If so, please state how many such definite compounds exist, and what is their composition, and in what standard chemical works they are described.

(Counsel for defendants renews his protest against the continuance of this line of examination, it being new matter introduced by complainant's counsel, not inquired into in the examination-in-chief, and the form of the complainant's counsel's questions is objectionable; counsel for defendants again insisting that the question involved in this suit is the manner in which defendants' products are produced, and not the nature or chemical composition of such products.)

A. I have nowhere asserted that there is any other well-understood compound of stearic acid and lime, than the one referred to in Cross-questions Nos. 44 and 45. I have simply stated that there may be an acid lime-soap, based on analogy from the well known acid soaps first pointed out by Chevreul; and this analogy will be recognized by the great majority of chemists, as no forced or unreasonable deduction.

X Q. 48. Can any of the acid soaps mentioned by Chevreul be separated into neutral soaps on the one hand and free fat acids on the other by mechanical squeezing?

A. I do not know that Chevreul ever did this, nor have I experimented with them myself.

X Q. 49. From your general chemical information, do you believe that an acid soap can be separated by mechanical squeezing into a neutral soap and free fat acids?

A. I do not think that it could, but in reference to the product of the defendants, as in my previous statements, I remarked that it may contain some free acid; that free acid might be to a greater or less extent, separated by pressure.

697 X Q. 50. If by such mechanical squeezing a neutral lime-soap was found to be separated from defendants' product, would you, as a chemist, think it probable that such neutral lime-soap had pre-existed as such, in defendants' product?

A. I cannot answer such a question without making the experiment myself.

X Q. 51. Would such an experiment, in your judgment, be an important one in throwing light on the question as to whether defendants' product is a mixture of neutral lime and soap and free fat acid, or whether it is a chemical compound or "acid lime-soap?"

A. As chemistry is considered an experimental science, whenever I give evidence as an expert I do so on my own experiments and those of

well-known chemists, experts, and the deductions from said experiments and researches; and as my examination of the subject throws no light upon it, I can venture no opinion upon it.

X Q. 52. In a manufacturing point of view, regarding the saving in the quantity of sulphuric acid necessary to be employed, does it make any difference whether defendants' product is considered theoretically as being an "acid lime-soap," or as a mixture of neutral lime-soap and free fat acid?

A. It makes no difference.

X Q. 53. Have you made any analyses of the defendants' product? If so, please give the result thereof.

A. I made some analyses of the defendants' product as taken from their digester, some three or four years ago. I have not examined the defendants' product as taken from his digester within the past two months, but have made a number of experiments recently upon the product made in my laboratory after the defendants' process.

X Q. 54. I understand, then, that you have not analyzed any of the products actually made in defendants' digester, according to the processes described in their original and supplemental answers filed herein; is that so?

A. I did not examine any of those products as prepared by the defendants in their digesters, but examined the defendants' product made according to said supplemental answer, in a manner far better, to furnish true and reliable results; as the experiments made in my laboratory at Louisville, *and* were entirely under my own control, and beyond all improper interference.

698 X Q. 55. Were the experiments just referred to as made in your laboratory made in the apparatus described in detail in your answer to Question No. 12 in chief?

A. They were made in said apparatus.

X Q. 56. Were the products thus obtained essentially the same as those produced in defendants' digester, in their factory, in your opinion?

A. In my opinion they were the same as those said to be produced in defendants' digester.

X Q. 57. What difference would there be in the products obtained if the defendants' digester was heated by an external steam-jacket, or other source of heat, instead of by internal steam?

A. There is certainly an advantage in passing the steam through the entire mass, keeping up an agitation, which I consider most important in facilitating the decomposition.

X Q. 58. If the same amount of agitation was kept up by mechanical means, would there be any difference in the products obtained if defendants' digesters were heated to the same degree by an external steam-jacket or other source of heat, instead of by internal steam?

A. There would be a difference, because no mechanical agitation can be so complete in subdividing the particles of fat and subjecting them to the agencies that bring about the decomposition in the defendants' process. There would be no difference in the products obtained at the conclusion of the operation.

X Q. 59. Is the process described in defendants' original answer filed herein substantially the same chemical process as that described in their supplementary answer filed herein?

A. While there are some important modifications in the process described in the supplementary answer, it is chemically essentially the same as the process described in the original answer; the essential modification being the manner in which the steam is applied, and in the quantity of lime, which is four instead of seven per cent.

X Q. 60. Is the process referred to by you as being used by DeMilly, in France, substantially the same chemical process as those described in defendants' original and supplementary answer?

699 A. It is substantially the same.

X Q. 61. Is the process described in the English patent to L. A. DeMilly, of Paris, 1856, No. 2740, substantially the same chemical process as that referred to you as being used by said DeMilly?

(Patent being produced and shown to witness.)

A. DeMilly's process, as I have witnessed and experimented with in his factory, is essentially set forth in the summing up in his said patent, on page 3, line 35, to page 4, line 15.

X Q. 62. What proportion of lime to fat does DeMilly use?

A. He uses now about two per cent.

X Q. 63. Suppose that only one per cent. of lime were used instead of two per cent., would the process of DeMilly remain essentially the same chemical process?

(Question objected to unless counsel for complainant will explain what meaning he attaches to the word "process;" whether he means thereby the results obtained at the conclusion of the operation, or the manner of producing those results.)

A. It would not be the same chemical process that I witnessed and read in letters-patent of DeMilly, as referred to in my last answer.

X Q. 64. You have already stated that processes employing seven per cent., four per cent., and two per cent. of lime were all essentially the same chemical processes. Please specify particularly, and in detail, the essential points of difference between the chemical actions involved and the chemical results produced in cases where two per cent. and one per cent. of lime were used respectively, which cause you to consider them to be essentially different chemical processes.

A. So far as I state that the use of seven per cent., four per cent., and two per cent. of lime are essentially the same chemical processes, I must be understood to refer to them so far as the proportions of lime and the action of other agents do produce given results. If it is meant by the complainant's counsel to know whether the chemical change is the same so far as the one per cent. of lime goes, of course I answer in the affirmative that it is.

700 X Q. 65. Then there is no more difference in the chemical process between cases where one and two per cent. of lime, respectively, are used in decomposing fats as above referred to, than there is between cases where two and four per cent., or four and seven per cent., of lime respectively, are used; is that so?

A. There is this much difference, that, to accomplish the result in the same time requires very different degrees of temperature.

X Q. 66. Is that the only difference?

A. Considering, as I do, the lime-soap first formed to operate to a considerable extent in bringing about the final decomposition of the fats, the larger the proportion of lime the greater will be the proportion of lime-soap formed, and consequently the more speedy will be the decomposition. So that, in this respect, there may also be considered to be a difference in the action, when the above proportions of lime are used.

X Q. 67. So that the only difference in producing the complete decomposition of the fat between cases where one and seven per cent. of lime, respectively, are used, is that the temperature or time, or both, may be diminished as the quantity of lime is increased; is that so?

A. Not altogether, for we must, in my opinion, add to this difference

the larger or smaller production of an additional decomposing agent besides the temperature, namely, the lime soap.

X Q. 68. Does a neutral lime-soap heated with water to a high temperature and pressure (say, 320° Far.) undergo decomposition?

A. I do not know, for I never tried the experiment, and I not know that it has been tried.

X Q. 69. What is the product of DeMilly's process, with two per cent. of lime?

A. I suppose it consists of acid lime-soap and free fat acid.

X Q. 70. What is the product of defendants' process with four per cent. of lime?

A. I believe there is enough lime to form an acid lime-soap with the entire mass, although I would not assert anything positive in regard to the true nature of any of the products of these decompositions.

701 Q. 71. What is the chemical or other action of the fine sand directed to be used in defendants' process, described in their original answer?

A. I do not see that it can have any action.

X Q. 72. What produces the free fat acid in De Milly's product, as referred to in Cross-answer No. 69?

A. This question I cannot answer without theorizing. Yet I have no objection if the complainant's counsel desires me to theorize. I would account for it in the same way that Chevreul showed that an acid soap could be decomposed by the mechanical action of alcohol upon it, so as to liberate free fat acid. (See Chevreul, Recherches sur les corps gras, page 42, paragraphs 85 and 86.) In De Milly's process I believe that the water used is capable, at the high temperature used, of liberating free fat acid from the acid lime-soap first formed.

X Q. 73. Then you believe that in De Milly's process the water at a temperature and pressure of eight atmospheres does not decompose any of the neutral fat into free fat acids and glycerine; is that so?

A. As previously stated, I believe that the various agents of heat, lime, water, and pressure co-operate in bringing about this decomposition; and whether or not in this process the water alone formed a free fat acid that never was combined with the lime-soap, it is impossible for me or any one else to say. I know that when water and fat are heated to a very high temperature, (referred to in complainant's patent,) that free fat acid is produced; which, of course, must remain free in all stages of the process, as there is nothing present that it could combine with.

X Q. 74. What proportion of lime or other base added to the fat and water, in complainant's process, would change it, in your opinion, into a different chemical process?

A. Whatever quantity would change the condition required to decompose the fats as set forth in the letters-patent of the complainant; whether that be one-quarter per cent. or any other quantity.

X Q. 75. Do you not know from your own experiments that when water and fat are heated together at temperatures and pressures even lower than used by De Milly, free fat acid and glycerine are produced?

702 A. Yes. My experiments have shown me that where water and fat alone were heated to a temperature of about 320° Far., that from ten to thirteen per cent. of the mass of fat was decomposed in eight hours.

X Q. 76. What hindered this same action of the heated water upon the fat taking place in De Milly's process?

A. There was nothing to hinder the process but the condition—presence of the lime does modify it to a considerable extent.

X Q. 77. Then, if nothing hindered the action of the heated water upon the fat, that action did take place in De Milly's process, did it not?

A. I have no evidence of the fact.

X Q. 78. What hinders the action of the heated water upon the fat in defendants' processes?

A. In this question it is assumed that I lay great stress upon the decomposing action of the water, when, as I have previously stated in my direct examination, that heat alone, in my belief, plays a most important part in these decompositions of fats, and whenever the conditions of any chemical decomposition are modified or altered, it is difficult to say what hinders or changes this or that part of the operation; therefore I am not prepared to give a direct answer to the question.

Here adjourned until 10 a. m. Friday, June 25th, 1869.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio,

Met pursuant to adjournment.

X Q 79. Then you cannot testify that there is anything that does hinder the action of the heated water from decomposing a portion of the fat in defendants' processes, in the same manner as the heated water decomposed a portion of the fats in your own experiments heretofore described; is that so?

(Counsel for defendants objects to the foregoing question, inasmuch as it assumes that the 10 to 13 per cent. of decomposition produced in the experiments of the witness referred to, was due to the decomposing action of the "water," whereas, in such experiments, both in the
703 laboratory and in the defendants' manufactory, as conducted by the witness, steam as well as water was employed; and steam, as testified by the witness, is a decomposing agent as well as "water.")

A. As I have in no place in my previous evidence expressed any explanation of the causes of the decomposition in the experiments referred to in the latter part of the question, I cannot answer the first part of the question in the relation it bears to the latter part. The only answer, therefore, I can give to the first part is that I cannot say that the action of the water is prevented in defendants' process. But I believe, as the result of my experiments and research, that at no time from the beginning to the end of the process is the action of the water exerted upon any part of the fat except conjointly with each and all of the other agents employed, to wit, steam, lime or the lime-soap, and heat; and that the result at each stage and at the conclusion of the operation is due to the combined energy of all the agents employed.

X Q. 80. Can you testify, from your personal knowledge and experiments, that the agents just named, to wit, "steam, lime or the lime-soap, and heat," (about 320° Fa'r.,) when used together with the fat, but without the presence of heated liquid water under pressure, will produce the products obtained by defendants' process, to wit, (so called) "acid lime-soap" and glycerine?

A. Of course, not being requested to make any such experiment, and it not occurring to me that it in any way affected the line of investigation I was requested to pursue, I cannot answer this question upon any experiments of my own.

X Q. 81. Were you examined as a chemical expert in the former suit

of complainant against M. Werk; and did you then become acquainted with the process used by Mr. Werk?

A. I was examined as a chemical expert in said suit, after the decree of the court, and when the cause was pending before the master on the question of damages. I then became acquainted with the process as used by Mr. Werk at that time.

X Q. 82. Is the process then used by Mr. Werk substantially the same chemical process as that described by defendant herein in their original and supplementary answer, as being used by them?

704 A. It is the same process with a larger amount of lime and a little higher temperature.

X Q. 83. When did you first hear of the process to decompose fats with a quantity of lime less than the chemical equivalent, used with water at a high temperature and pressure?

A. I first heard of a practical application of a "quantity of lime less than the chemical equivalent," to produce decomposition of the fats, in 1855; but I have discovered by subsequent investigations that, prior to that period, (as early as 1825,) the fats had been decomposed by less than an equivalent of alkali, as shown at that period by the researches of Chevreul and the letters-patent of Gay-Lussac.

X Q. 84. What were the products of said decomposition of fats with a quantity of lime less than a chemical equivalent, as shown by the researches of Chevreul and the letters-patent of Gay-Lussac?

A. I do not state that lime was the alkali employed in the experiments referred to in the last answer, for potash was the alkali used. Chevreul did not in his experiment use lime; nor in the paragraph referred to in Gay-Lussac and Chevreul's patent was lime used. It may have been either soda or potash, and I infer from the analogy of the action of lime and potash upon the fatty bodies, that analogous results would be produced. The experiment referred to in my last answer, with reference to the decomposing of fats by less than an equivalent of alkali by Chevreul, is to be found in his Recherches sur les corps gras, page 373, paragraph 1051, chapter 5, where, by the action of a quantity of potash equal to but one-half an equivalent, lard was decomposed, forming a homogeneous mass entirely soluble in boiling alcohol, a clear evidence to my mind that there was but a very small quantity of decomposed lard present; for had there been, the alcohol would not have dissolved it, as alcohol dissolves only a little over 2 per cent. of lard. In reference to Gay-Lussac and Chevreul's letters-patent, taken out in 1825, (see Defendants' Exhibit No. 6, the 2nd paragraph on page 7.) In this paragraph the patentees claim to conduct their saponification with the "smallest quantity of alkali;" and, in the next paragraph on the same page, while speaking of the manner of decomposing said saponification by the "smallest quantity of alkali," states that the

705 action of water is to resolve it into oleate of an alkali and acid fat soaps, which could only have occurred by patentees having used originally less than an equivalent of an alkali.

X Q. 85. Having given special study to this branch of chemistry, you are of opinion, as a chemist, that it is evident from the experiment of Chevreul, referred to by you, that the potash had saponified more than the quantity of fat which it could convert into neutral soap. Is that your opinion?

A. Using the word "saponification," as now used in the arts to signify decomposition of fats, so as to separate the fatty acids, that is my opinion.

X Q. 86. Does Chevreul, in his book quoted, give that as his opinion?

A. Chevreul gave, as his opinion, that the result of this experiment was the production of glycerine, a neutral soap, and acid stearate, an acid margarate, an acid oleate of potash, and an unaltered fat.

X Q. 87. I understand you to say, then, that Chevreul's conclusion from the experiment quoted is, that the potash had saponified (or "decomposed so as to separate its fatty acids,") more than the quantity of fat which it could convert into neutral soap; is that so?

A. He concluded that the potash had not saponified more fat than the alkali could convert into neutral soap, stating that the acid soaps were probably formed by the action of the water upon the neutral soap.

X Q. 88. Directing your attention to the passage in Chevreul, page 375, paragraph 1055, referring to the experiment you have quoted, (from paragraph 1051,) as follows: "It is evident that in the foregoing experiment, the potash had only saponified the quantity of fat which it could convert into neutral soap," I now ask you whether the experiment of Chevreul referred to, proves that potash can saponify (or "decompose so as to separate its fat acids") a quantity of fat greater than it can convert into neutral soap, or does he state the precise reverse to be the fact?

A. My own conclusion from the experiment, paragraph 1051, was that the potash had decomposed more than its equivalent of fat. Chevreul's opinion, in 1055, was that the potash did not decompose more than its equivalent of fat, and that the acid potash-soaps found in his
706 experiments resulted from the subsequent action of water. While my deduction differs from that of Chevreul with reference to the results of this experiment, I feel authorized, notwithstanding the elevated position that Chevreul holds in the scientific world with reference to his researches on fatty bodies, to differ with him in his conclusion. Nor is it the first time that I have differed with him in his conclusions with reference to certain points in his researches on fats; for as much as twenty-five years ago, in studying his researches, I remarked, that, notwithstanding that he gave as the result of his experiments upon a well-known fatty body, namely, spermaceti, that the solid acid obtained as the result of saponification of the same, melted at a point lower than that at which margaric acid melted, yet he concluded that the solid acid from spermaceti was margaric acid. In this conclusion I differed with him, and undertook a series of chemical researches on spermaceti, in which I proved that Chevreul's deduction was incorrect, and that mine was correct, for I found the solid acid to be athalic, more commonly known as palmitic acid, a conclusion which was at once adopted by Liebig, Dumas, Berzelius, and others; and for criticism on said researches, I would refer to Berzelius' annual report of the progress of chemistry, in 1842.

Furthermore, Chevreul himself states, on page 173 of his researches on fatty bodies, paragraph 518, second part, "that the presence of margarate of potash (a neutral soap) favors very much the action of potash on spermaceti (a neutral fat;) for in the experiment described, paragraph 516, the weight of spermaceti, saponified, was 3,095, while in an experiment made comparatively with that in paragraph 516, and absolutely under the same circumstances, where 7,000 of spermaceti (fusible at 48° C.) was exposed to the action of 1,100 of potash dissolved in water without margarate of potash, (a neutral soap,) the quantity of spermaceti acidified (saponified) was only 576." From the above it will be seen why I differ with Chevreul in deductions from his own experiments.

X Q. 89. At what date did you first come to the conclusion that the

opinion of Chevreul as to the result of his own experiment (paragraph 1051, referred to by you) was erroneous, and that the contrary opinion was correct?

A. Not until my attention was called to the investigation of the process of the defendant, say within the past twelve months.

707 X Q. 90. Did you there repeat the said experiment described by Chevreul, (paragraph 1051,) and get a different result than that recorded by him?

A. I did not repeat the experiment recorded by Chevreul, but took for granted that his experiment was correct in producing a homogeneous mass, completely soluble in alcohol. I merely reviewed it in this light, and came to my own conclusions in reference to the nature of the changes.

X Q. 91. Then, from Chevreul's own account of his own experiment, you decided that he was entirely wrong in his conclusions therefrom; is that so?

A. No, it is not; for I have nowhere stated that Chevreul was entirely wrong in his conclusion. I have merely stated that I differed with him in his opinion, and that he may be wrong.

X Q. 92. In differing in opinion from Chevreul, do you now think that you are right and he is wrong, or that you are wrong and he is right?

A. It is my opinion that I am correct, but I would be careful myself against asserting this in a positive manner, without a set of experiments made by myself, which might in the end prove Chevreul to be correct.

X Q. 93. Then, at present you have no fixed, definite, and positive opinion as to whether Chevreul or yourself is right; is that so?

A. I have a positive opinion, subject to the qualification referred to in my last answer, namely, the repetition of the experiment.

X Q. 94. Referring to your answer to cross-question eighty-four, referring to Chevreul's said experiment, are you still of opinion that the solubility of the "homogeneous mass in boiling alcohol" is a clear evidence that there was but a very small quantity of undecomposed lard present? Please consult the work before answering.

A. I am still of opinion that the quantity of neutral fat remaining undecomposed was very much less than would have been found if the potash-soap, first formed, had not decomposed a considerable amount of the remaining lard; and Chevreul distinctly states that he found neutral soaps, acid soaps, and undecomposed lard.

X Q. 95. Up to the time when you discovered Chevreul's mistake, (if it be a mistake,) as referred to in your answers to ques-

708 tions eighty-eight to ninety one, inclusive, was the correctness of his conclusion undisputed in chemical science, as far as you know?

A. I nowhere state that "I discovered Chevreul's mistake" in anything connected with his experiment in paragraph 1051, nor do I mean, by my opinion of the result of the experiment, that "I discovered Chevreul's mistake," any more than Christopher Columbus' opinion of the existence of the Western Continent, expressed in the court of Ferdinand and Isabella, before he had first sailed, would have entitled him to have asserted that he had discovered that continent. So far as regards the correctness of Chevreul's opinion, with reference to the result of the experiment in question, I do not know that it was ever disputed or ever noticed by other chemists.

X Q. 96. Can you produce any standard chemical treatise of date prior to 1854, which states distinctly that fat can be decomposed into

"acid soap" (so called) by a quantity of alkali less than the chemical equivalents of the fat, in the presence of water, at a high temperature and pressure.

A. I cannot produce any work stating that fact in so many words, but the inference to be deduced from the specification of the patent of Chevreul and Gay-Lussac, in 1825, lead, I think, to a just conclusion that such was accomplished, for the patentees claim, in said patent, among other things, to operate "with an elevated temperature with the pressure of several atmospheres, in conjunction with potash, soda, and the other bases, by the acids, or by any other means, the saponification being accomplished with the smallest possible quantity of an alkali;" and a little further on in speaking of the decomposition of the soaps thus formed, where water was added to the mass, the result of the formation of one neutral and two acid soaps, shows to my mind that even at that time fats had been decomposed, to the knowledge of the patentees, by less than an equivalent of alkali, in a closed vessel, with water, steam, and pressure; which circumstance shows to my mind the object the patentees had in claiming a "saponification with the smallest possible quantity of alkali," they having nowhere in their patent stated any definite quantity of alkali or base to be used by them.

X Q. 97. Can you produce any scientific, chemical, or technical work, published before 1854, which states, in any plain, intelligible
709 language, either with respect to Gay-Lussac's patent or any other, that fats can be decomposed into acid soaps (so called) by a quantity of alkali less than the chemical equivalent, in presence of water, at a high temperature and pressure?

A. I know of no technical work stating that fact in such "plain intelligible language" as to enable any one to carry out the result practically; but the scientific work before alluded to (Chevreul's Recherches, see page 371, paragraph 1051,) if critically studied would in my mind ultimately lead to such practical results as have been obtained in saponification, by a small quantity of alkali less than an equivalent.

X Q. 98. Was it not discovered and published by Chevreul in his work alluded to, that a neutral soap of potash or soda, by being dissolved in a large quantity of water, would be decomposed into an acid soap which would precipitate, on the one hand, and into a very alkaline soap, which remained dissolved in the water, on the other hand?

A. Chevreul states as the result of dissolving 1 part of neutral stearate of potash in 100 parts of boiling water he obtained on the cooling of the mixture, a solid matter which is represented by a neutral stearate of potash and bistearate of potash, and water, which retains a little more than one-fourth of the potash of the neutral stearate used in the experiment, (page 34, paragraph 67.)

Here adjourned until 10 a. m., Saturday, June 26th, 1869.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

Met pursuant adjournment.

X Q. 99. Can you state, from your own opinion, and from the authority of standard chemical works, whether a similar separation of solid acid soaps, takes place when a neutral soap made of tallow and potash, and therefore containing oleate as well as stearate of potash, is dissolved in water?

A. I would state, as my opinion, that a similar decomposition would take place under the same condition of experimenting; and the state-

ment of the experiment, made by Chevreul, page 86, paragraph 214, would seem to substantiate this opinion.

X Q. 100. Is the decomposition of the soapy mass by water,
710 spoken of in Guy-Lussac and Chevreul's patent, the same kind of decomposition as that referred to in your last answer?

A. No, it is not; for my opinion is, in reading the letters patent where he claims the right to decompose the fat with the smallest quantity of alkali, and that under high heat and pressure, that the decomposition referred to in the question was originally made with a less quantity than the equivalent of alkali; and that the mass of fatty soaps, resulting from the decomposition before the water had been added (at the termination of the operation,) already contained acid, stearate, and margarate soaps, and neutral oleate soap.

X Q. 101. Does Guy-Lussac and Chevreul's patent state that the same or different products were obtained, when operating at ordinary boiling temperatures on the one hand, and at more elevated temperatures and pressures on the other hand?

A. They do not state that different products are produced under these different circumstances; they simply state with reference to these two methods of saponification, the one in the open air and the other under pressure of several atmospheres, presents great advantages over that practiced under the ordinary atmospheric pressure.

X Q. 102. Do you, as a chemist, understand from Gay-Lussac and Chevreul's patent, that the product of their saponification, when operated at ordinary boiling temperature and pressure, was the same, or a different substance from the product of their saponification, when operated at a more elevated temperature and a pressure of several atmospheres?

A. So far as the final production of certain industrial products, namely, stearic, margaric, and the oleate acids, they were the same in both cases, under all circumstances. So far as the immediate products of saponification were concerned, when they used in both cases a full equivalent of alkali, they were the same. So far as the products of immediate saponification were concerned, where a full equivalent of alkali was used in one case and less than an equivalent in another, they were not the same.

X Q. 103. What do you understand by the expression "the smallest possible quantity of alkali," as used in Gay-Lussac and Chevreul's patent?

A. By the light thrown upon the subject, by the paragraph
711 in his patent, where he shows by the action of water upon the mass taken from the digester, that it contained an oleate and acid alkaline soaps, it is evident to my mind, in that case he must have used less than an equivalent of alkali.

X Q. 104. How much less?

A. That I cannot tell, because he does not give the exact proportion of these different alkaline soaps.

X Q. 105. Can you not tell whether it was more or less than one-half of the chemical equivalent of the fat?

A. That i cannot from the statement made in said patent: but, so far as my mere opinion is concerned, they used more than a half equivalent.

X Q. 106. It is your "opinion," then, that more than "a half equivalent" is "the smallest possible quantity of alkali," contemplated in Gay-Lussac and Chevreul's patent, is that so?

A. By no means, for I cannot go behind the expression of the patent from which I quoted, when the expression is used, "the smallest possible quantity of alkali," giving them, as I suppose, the right to use a quarter of an equivalent or less (if that should accomplish the result;) but, so

far as regards my opinion of their manner of operating, in connection with the technical application of their patent, I do not believe that they ever operated with this very small quantity of alkali.

X Q. 107. Do you not believe that a "quarter of an equivalent or less" of an alkali, "would accomplish the result?"

A. If this proportion of an alkali be used in one of the methods specified in said patent, namely, operating in conjunction with water, high heat, and pressure, it would.

X Q. 108. It is your "opinion," then, that a "quarter of an equivalent or less" of alkali, is contemplated in Gay-Lussac and Chevreul's patent, to be used in "operating in conjunction with water, high heat, and pressure," to decompose fats into acid soaps: is that so?

A. I do not state in any of my answers, or intend so to state, that it is my opinion that the patentees contemplated using the proportions of alkali referred to in the question. I merely state that they claim, and, in my opinion, have the right to use, just what they claim.

X Q. 109. Do you understand from Gay-Lussac and Chevreul's patent, that they also contemplated the use of lime in "the smallest possible quantity?"

712 A. So far as regards what they contemplated, when they claimed to use the "smallest possible quantity of alkali," it is my opinion, that they did not contemplate the use of lime in the "smallest possible quantity;" for, although their letters-patent give to them the right of using lime, they seem never to have employed it in the decomposing of fats.

X Q. 110. How small a quantity of lime do you understand from their patent, that they contemplated using when operating in conjunction with water, at a high temperature and pressure to decompose fats?

A. The only reference to the use of lime in their patent is where in their patent they claimed "the saponification of fats by potash, soda, or the other bases, by the acids, or by all other means," and lime and the other bases, other than potash and soda, do not seem to have occupied their attention at all; and therefore, I think that they did not contemplate anything, one way or the other, about lime.

X Q. 111. Can you find in Gay-Lussac and Chevreul's patent, now before you, anything to show that they contemplated the use of lime in quantity less than the chemical equivalent, in conjunction with water at a high temperature and pressure to decompose fats? If so, please quote the words.

A. As I stated in my previous answer, that they did not contemplate the use of lime, any further than referred to in their general claim, of course it is my opinion that they did not contemplate the use of lime in a small or any other proportion, in their practical operations, either at a high or a low temperature, with or without pressure.

X Q. 112. I read from Gay-Lussac and Chevreul's patent, Defendants' Exhibit No. 6: "First, we decompose by water the soapy mass obtained by saponifying grease, tallow, etc., by an alkali; the water dissolves the oleate to the exclusion of the great mass of the stearic and margaric acids, which are left behind in the state of supersalt (sursels.") Do you find anything in the patent to indicate whether it was at common boiling temperature on the one hand, or at a more elevated temperature and pressure on the other hand, that the "soapy mass" was "obtained by saponifying grease, tallow, etc., by an alkali?" If so, please quote the words.

A. I suppose that the term, supersalt (as translated,) to mean
713 what I have been referring to as acid-soaps; and I do not find

anything in the patent which shows, under which conditions, whether at ordinary or high pressure, these acid-soaps and oleates were formed.

X Q. 113. Do you understand from Gay Lussac and Chevreul's patent, that "the soapy mass obtained by saponifying grease, tallow, etc., by an alkali," as it came from the boiler in which the saponification had been effected, was an acid soap?

A. The soapy mass, as referred to in the quotation made in cross-question No. 112, I understand must have been an acid soap, if his record be correct, although I have no doubt in most of his saponifications the soaps were neutral.

X Q. 114. Is there anything in the patent to show when the said "soapy mass" was an acid soap, and when it was a neutral soap, or whether, in any particular case, it was the one thing or the other? If so, please quote the words.

A. The only place in the patent that it can be said that an acid soap was formed, is where it is stated that the "water dissolves the oleate to the exclusion of the great part of the stearic and margaric acids, which remain in the state of acid soaps." Reading the rest of the patent as a whole, I infer that the patentees aimed at speedy, practical, and remunerative results; with this view of the subject, common to all patentees, I suppose that most certainly the greater part of the operations (certainly those carried on in open vessels) must have had a sufficient quantity of alkali, to bring about rapid decomposition, with the formation of neutral soaps.

The testimony of this witness not being concluded, and he being desirous of returning to his residence, at Louisville, Ky., Mr. C. B. Collier, defendants' counsel, proposes to produce the witness before a competent officer, at Louisville, on notice to complainant, and that this deposition may now be signed by the witness, with the understanding that it is not to be used until the witness has been tendered for further cross-examination; to which proposition Mr. B. C. Tilghman, complainant's counsel, assents.

J. LAWRENCE SMITH.

714 LOUISVILLE, KY., *July* 7, 1869.

Examination of J. Lawrence Smith resumed.

Present, complainant and his counsel, B. C. Tilghman, esq., and Chas. B. Collier, esq., on behalf of the defendants.

It is hereby agreed that the examination of J. Lawrence Smith shall proceed, and be conducted in the absence of the notary; the answers to be written by the witness, and the deposition, when concluded, to be signed by him; and that the testimony so taken shall have the same force and effect as if the same had been taken in the presence of the notary in the usual manner.

All objections as to the manner of examination, as stated, being hereby waived.

CHA'S B. COLLIER,
Solicitor for Defendants.
GEORGE HARDING,
Solicitor for Compl't
per B. C. TILGHMAN.

X Q. 115. Do you mean to say that Gay-Lussac and Chevreul's patent nowhere states or describes the direct product of their process of saponification to be an acid soap?

A. They do not state or describe in their patent their direct products formed to be acid soaps. It is simply inference that I infer in the case I cited in X Ans. 100 that acid soaps were formed.

X Q. 116. Does Gay-Lussac and Chevreul's patent contain any plain, distinct, intelligible instructions for forming acid soaps as the direct product of saponification? If so, please quote the words of such instructions.

A. It does not.

X Q. 117. Would not the quantity of alkali and acid consumed be the principal expense in the manufacture of fat acids by the process of Gay-Lussac and Chevreul?

A. They would be.

X Q. 118. Would not one-half of all the acid and alkali required
715 have been saved by them, if they had known and plainly described any method whereby acid soaps would be formed as the direct product of saponification?

A. There would have been such saving.

X Q. 119. From the time Gay-Lussac and Chevreul's patent up to 1854, has it not been generally stated in chemical and technical works, that the direct product of the lime-saponification process, was a lime-soap, meaning thereby a neutral lime-soap, or with an excess of lime?

A. It has been so understood.

X Q. 120. You have referred in answer to Ques. 7, in-chief, to the paper by Faraday, to the change of fat in Perkins' engine. Please state all the proofs, if any, contained in said paper, (Dep. Exh. 1;) that the changed fat there described was free fat acid.

A. There was a substance formed perfectly soluble in alcohol, "soft and even fluid," which when burnt only left a "slight ash of carbonate of lime," which substance Faraday distinctly states resembles Chevreul's "acid of fat"; [and the correctness of this deduction is placed beyond all doubt in my mind, since the subsequent investigation of high-pressure steam, with or without water, upon fats, for it seems clear to me, as it must to all chemists, that it would have been impossible for the fats used in lubricating Perkins' engine to have escaped the decomposition, resulting in the formation of fat acids.]

(The part of said answer enclosed in brackets is objected to by complainant's counsel, as containing witness' inferences drawn from "subsequent investigations," and not proofs derived from the statements in Exh. 1 itself.)

X Q. 121. Please read Exh. 1 carefully, and say whether you are correct in saying that "Faraday distinctly states" the "soft and even fluid" substance, to "resemble Chevreul's acid of fat.

A. The statement that I referred to in my last answer is contained in that part of Exhibit 1, where Faraday describes a portion of the product which, in my mind, was a mixture of fat acid and a little lime-soap, (this last being doubtless formed by the fat acid arising from the decomposing effect of the steam and water, or the fat, and the subsequent combination of this acid with a little carbonate of lime, a not uncommon accompaniment of water;) and in this part of the exhibit, Faraday, after referring to its being lighter than water, readily
716 soluble in alkalies, more readily than fat, also soluble in alcohol, says in "this respect resembles Chevreul's acid of fat."

In the paragraph referred to by me in my last answer, (speaking of the cold alcoholic solution referred to, line 36,) Faraday says it left on evaporation a substance similar in many respects," &c., which state-

ment of his evidently referred to what he says in the previous paragraph about the resemblance of the substance to "acid of fat."

X Q. 122. Then the only reason you can give, derived from the exhibit itself, to show that the "soft and even fluid substance" was free fat acid, is, because this "soft substance" is stated to be "similar in many respects" to the "grayish substance previously mentioned in Exh. 1, which grayish substance is stated to have "resembled Chevreul's acid of fat," in certain particulars? Is that so?

A. This is the only direct statement that Faraday has made on the subject. But a very strong inference can be drawn from its complete solubility in cold alcohol. And still a stronger inference can be drawn from the fact that neutral fats, exposed as that which Perkins used, to a very elevated temperature under pressure with steam and water, must have been decomposed and fat acid formed; if this were not so, all that is now supposed to be so definitely known, about the decomposing effect of heat, pressure, steam, and water on fats, is but a mere scientific and technical fallacy.

X Q. 123. Do you mean to say that your strongest reason for inferring that the product from Perkins' engine was free fat acid, is your present knowledge that fats will be decomposed into free fat acids and glycerine by the action of water, at a high temperature and pressure?

A. The strongest inference is as I stated above, that fat cannot be exposed to high heat, pressure, steam, with or without water, without undergoing decomposition.

X Q. 124. Did you ever see, hear of, or read of, a free fat acid of oil or tallow which would not melt in boiling water, and was insoluble in ether or nearly so?

A. I never did.

X Q. 124½. Can you, as a chemist, recognize a substance described as being insoluble in ether, or nearly so, to be free fat acid of oil or tallow?

717 A. So far as my memory serves me, I should say not.

X Q. 125. Can you, as a chemist, recognize the "grayish substance" which is described in Exh. 1 as not melting in boiling water, and as being insoluble in ether, or nearly so, to be free fat acid of oil or tallow?

A. From Faraday's description, we must infer that the grayish substance was either free fat acid and a lime-soap, or an acid lime-soap; that it was only free fat acid, his own statement, in regard to the substance leaving a residue of carbonate of lime, shows was not the case.

X Q. 126. It is certain that this "grayish substance" consisted in part at least of lime-soap, is it not?

A. In the description we have of this investigation, made at a time when researches in organic chemistry had hardly more than commenced, we have to learn much in reference to the true nature of the results then obtained by the light of more recent investigations. So that, beyond the statements of Faraday, all the rest is simply inference. Faraday himself does not state anything in his remarks about a lime-soap.

X Q. 127. Is it not certain that the lime in the "grayish substance" must have been in chemical combination with the fat, inasmuch as it dissolved with the fat in the hot alcohol, and precipitated with the fat (forming flocculi) on the cooling of the alcohol?

A. In my opinion such is the case.

X Q. 128. Then the chemical combination known as "lime-soap" must

have been present in the "grayish substance" in quantity corresponding to the lime found in it, must it not?

A. I should say so.

X Q. 129. And if the lime found in it was in quantity equivalent to the fat present, the "grayish substance" would have consisted entirely of neutral lime-soap, would it not?

A. I should suppose so.

X Q. 130. The question whether this grayish substance was a neutral lime-soap or not, would depend entirely upon an unknown fact, viz, whether the unknown quantity of lime present in it was greater or less than the chemical equivalent of the unknown quantity of fat present in it. Is that so?

A. I should say it was.

718 X Q. 131. Will not a neutral lime-soap by digestion in hot alcohol give a solution which, on cooling, will let fall a precipitate consisting of the larger portion of the neutral lime-soap dissolved?

A. I have never tried this experiment and cannot answer.

X Q. 132. Can you testify positively to the contrary?

A. I can not testify either one way or the other on a point in technical science that I have not experimented with, and about which, I am told, there is difference of opinions among those who speak of the matter within their own authority and that of others.

X Q. 133. Will not a neutral lime-soap dissolve in strong alkalies, making a turbid solution consisting of a solution of an alkaline soap, holding in suspension free lime, which causes the turbidity?

A. That I cannot tell, but suppose it might; I cannot refer to any author who seems to have tried the experiment.

X Q. 134. Confining yourself strictly to the chemical properties of the "grayish substance" as they are described in Exh. 1, can you name any which would enable you to testify positively that said "grayish substance" contained any free fat acid whatever? If so, please state the properties.

A. None that would enable me to testify positively that such was the case, but some that would lead me to infer that such might be the case.

X Q. 135. In a neutral lime-soap made by saponifying a mixture of equal parts of olive-oil and tallow, there would be a quantity of oleate of lime mixed with stearate of lime, would there not?

A. There would be.

X Q. 136. Gmelin's Chemistry, London, 1865, v. 17, p. 70, states that oleate lime melts at a gentle heat, and becomes transparent; dissolves in alcohol and ether. Supposing this to be correct, and that a quantity of neutral lime-soap made from oil and tallow had been digested in hot alcohol, and the clear solution cooled, would not the cold alcoholic solution probably contain some neutral oleate of lime?

A. Certainly it would, if I take as authority one who says that oleate of lime is soluble in alcohol and ether. I have not that authority to refer to at this time to see what researches he refers to, and in what proportions or under what conditions said solution takes place.

719 X Q. 137. From the description in Exh. 1 it is certain, is it not, that the "soft and even fluid substance" did consist in part at least of lime in chemical combination with the fat in the state known as oleate of lime?

A. To my mind it is certain that "the soft and even fluid substance' was essentially free fat acid, perhaps as free from lime, or nearly so,

as the ordinary technical fat acid used in the arts. Of course, what trace of lime there was present I believe to have been in combination with its equivalent of fat acid. All of my above conviction is based upon the description as set forth in the various parts of Exhibit No. 1.

X Q. 138. Please quote from Exh. 1 all the passages containing any proof that the "soft and even fluid substance" there described was essentially free fat acids.

A. First. The title of the article as given by Faraday himself, "change of fat in Perkins' engine by water, heat, and pressure," clearly shows that this chemist did recognize and prove that a change had taken place in the fats that had been subjected to the action of Perkins' engine.

Second. The substance under consideration, "the soft and even fluid substance," was very soluble in alcohol, as it furnished a clear solution in cold alcohol.

Third. Faraday refers to that substance as resembling the fat acids of Chevreul, and if Faraday's opinion is worth anything in any part of the exhibit, it should certainly have weight with myself and others, so far as the then known properties of fat acids were generally understood.

Fourth. That this substance could not be regarded as a neutral fat from its marked solubility in cold alcohol, and as it contained only a slight amount of lime, as shown by the "slight ash of carbonate of lime" left after combustion; and, furthermore, as it was produced from a fat, there are the strongest grounds for supposing that it was a free fat acid with a little trace of lime-soap, and I should so have regarded it had I first seen the article at the time that Faraday first made it public.

X Q. 139. Inasmuch as neither the quantity of alcohol used nor the quantity of the soft and even fluid substance obtained by its evaporation is mentioned in Exh. 1, please state your authority for asserting in your last answer that it was "very soluble in cold alcohol."

720 A. I infer that from the fact that it is supposed he had a reasonable quantity of material to operate with, and in the absence of positive statements in regard to quantities we are entirely left to our own inferences, and I do not pretend to say that my evidence goes any farther than that

X Q. 140. Then you actually know nothing as to what the quantities employed were, and you do not know that the "soft and even fluid substance" was "very soluble in cold alcohol," or that it had a "marked solubility in cold alcohol?" Is not that so? And do you wish these assertions to remain a part of your answer to X Q. 138?

A. Of course, not knowing the actual quantity used, the inference made with reference to the substance being "very soluble in cold alcohol" was one of those legitimate inferences allowed to chemists in reviewing the labors of others where definite quantities are not given. In the present instance, where one is forced to adhere more closely to the exact letter of the exhibit, it is but proper to strike out the words "very and marked," and it is my desire that it be done.

X Q. 141. Then, knowing nothing as to whether the "soft and even fluid substance" was very soluble in cold alcohol, or the direct reverse, your only remaining grounds for supposing that it was free fat acids are, first, that it is stated to be "similar in many respects" to the "grayish substance" previously described in Exh. 1, and, second, that it burnt in the same manner, leaving a slight ash of carbonate of lime? Is not that so? Or, if you can show other definite proofs existing in the exhibit, please quote them in the precise words of the exhibit.

A. When you ask for proofs in the matter, so far as regards their operation on my own mind is the only way that I can form any conclusion, and it is by taking the exhibit as a whole that I find sufficient proof and undertake to give my opinion; and due regard for the principles which govern me in chemical deductions bind me to the conclusions I have stated in Cross-answer 138.

X Q. 142. Which of the chemical properties of the "soft and even fluid substance," as said properties are described in Exh. 1, lead you to the conclusion that it was free fat acids? Please quote the description of said chemical properties in the precise words of the exhibit.

721 A. The answer to Cross question 138 embodies all that I have to say on the subject.

X Q. 143. Is the "soft and even fluid substance" named or described in any part of Exh. 1, except in the following passage, viz:

"The cold alcoholic solution on evaporation left a substance similar, in many respects, but much softer—even fluid. It burnt in a similar manner, leaving a slight ash of carbonate of lime. The merest trace of copper was found in these substances."

A. It is not referred to specially in any other part.

X Q. 144. To what was this substance similar *to* in many respects?

A. It was "similar in many respects" to the article previously referred to as depositing from the alcohol in flocculi, and which Faraday states resembles Chevreul's acid of fat."

X Q. 145. You mean to say that it was similar to the "grayish substance," (formed by fusing the flocculi,) the chemical properties of which are previously described in the exhibit. Is that your meaning?

A. I mean to say that it was similar to the flocculi, which, in fusing, gave a grayish substance.

X Q. 146. Are you correct in saying, in answer to Cross-question 144, that Faraday states that the flocculi or grayish substance "resembles Chevreul's acid of fat?" Does not Faraday state that it resembled Chevreul's acid of fat in only two particular properties, and does he not mention others which you know to be precisely the opposite of the properties of Chevreul's acid of fats?

A. Faraday mentions two respects in which he considers the substance to resemble "Chevreul's acid of fat." He mentions other properties which show that he was not operating with pure free fat acid, or fat acid unmixed with lime or other substance.

X Q. 147. You have already stated that none of the chemical properties of the "grayish substance," as they are described in Exh. 1, would enable you to testify positively that it contained any free fat acid whatever. I now ask you which of the chemical properties of the "soft and even fluid substance" described (confining yourself strictly and accurately to the chemical properties described in the Exhibit) would enable you to testify positively that said "soft and even fluid substance" contained any free fat acid whatever?

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A. It must be understood that when I answered the Cross-question 134, in regard to "testifying positively," I understand by testifying positively to mean to know to a certainty, and with such an understanding I answered the first part of the Cross-question 134, but adding, in the same answer, that there were some properties "that would lead me to infer that such might be the case," viz, that there were free fat acids present; and for the same reason, while I cannot testify positively about the "soft and even fluid substance" on so short and imperfect a description as Exhibit No. 1, I am convinced that there are even stronger reasons for supposing that the soft and even fluid substance contained

more or less free fat acid. For further elucidation of my opinion, see answers to cross-questions 125 and 138.

X Q. 148. Please verify the correctness of the annexed translation from *Per*et's Encyclopedia—Manufacture of Fat Acids, Paris, 1849, p. 82, viz: "The foreign substances, such as vegetable albumen, or mucilage, which occur in crude palm-oil, exercises upon it a remarkable action. It undergoes a decomposition of the glyceric compounds by which the fat acids are set at liberty, as also the glycerine, which separates without alteration. This decomposition, which is known by the name rancidity—the state in which palm-oil nearly always arrives with us—is then favorable to the treatment of this substance and to its application to the manufacture of palmitic candles. We have said that palm-oil arrives in Europe in a state of rancidity, more or less advanced; that is to say, containing more or less free acids, no longer combined with glycerine. The quantity of this free acid increases with age, and at the same time the melting-point gets higher. MM. Pelouze and Bendet have found in fresh palm-oil one-third of free acid. In some, which melted at 31° Cent. one-half, and in another specimen, which melted at 36° C.. even four-fifths of its weight. In very old palm-oil, the melting-point becomes elevated even up to 37° Cent." Does the above statement agree with general experience and with your own? Did you ever examine any palm-oil of commerce that did not contain free fat acid?

723 A. I have never examined the question except in a most casual way. The palm-oil I have seen has been more or less rancid, and the authors cited by Roret (Manuel des acids gras) are to be relied on. The translation from Roret I have verified as correct.

X Q. 149. Is it not the fundamental and essential condition of the process of distillation, as understood by chemists, that the substance distilled should be converted into gas or vapor?

A. The fundamental principle of distillation of any substance per se, that is to say, when alone, is the conversion of that substance into what is known as a gaseous vapor. When, however, two substances that do not mix, and have very different temperatures at which they distill, rapid distillation of both substances may occur at one and the same time, at a temperature much below the distilling-point of the least volatile. In what condition this last substance is when distilling has never been determined—whether as a gaseous vapor, or in an exceedingly minutely-divided state, yet not a gaseous vapor proper—no one has ever determined; and I do not see how it could be determined experimentally.

X Q. 150. Referring to Def'ts Ex. 12, was the fat acid described therein as having been distilled converted into vapor?

A. The fat acid here distilled was carried over in manner similar to that in which many substances are distilled, by heating with water when those substances by themselves would require a high temperature to distill them, the steam formed by the water carrying over such substance, it may be in the form of vapor, or it may be, as mentioned in the last answer, in a condition not (properly speaking) a gaseous vapor. In my own mind, it is analogous to the evaporating effect of a current of air on the surface of water exposed to it. In still air the water would evaporate slowly. With the air in motion, and the temperature remaining the same, the evaporation would be rapid.

X Q. 151. In Scharling's process, do you understand that the fatty substance found in the condenser was of a different nature from that left behind in the still? If so, what was the difference?

A. I understand from Scharling's experiments that he operated for

two hours, with two pounds of fresh palm-oil, in his first experiment, and that during that time one-half of the palm-oil acid had passed
724 over as free fat acid. The other portion remaining behind was doubtless palm-oil, more or less unaltered, and had he continued the experiment with the necessary precautions he sets forth, nearly the whole of the mass would probably have passed over, (the impurities, and possibly some altered organic products, remaining behind.) Scharling says he did not investigate very clearly the acids distilled in the residue. In his treatment by steam of castor-oil and tallow, he says nothing further on the residues to enable me to come to a definite conclusion as to what the residue consisted of.

X Q. 152. The free fat acids existing in commercial palm-oil, as mentioned by Pelouze & Bendet, would have been the first portion to distill over, would it not?

A. Had there been free fat acids in the palm-oil used by Scharling, they doubtless would have been the first to pass over.

X Q. 153. As far as such pre-existing free fat acids are concerned, there would have been no decomposition of neutral fat, and no production of glycerine. Is that so?

A. There would not.

X Q. 154. Does it agree with your knowledge of the process of distillation, or do you find any evidence in Ex. 12, that in Scharling's experiment the ebullition split up the oil into small particles, which were carried over by the elastic force of the vapor, as dust will be floated and carried off by the air?

A. There is nothing said in this relation in the record of the experiments of Scharling, as contained in Exhibit No. 12. I do not believe that it was carried over as dust is floated and carried by air, but I do think it may have been carried over in the way that one substance may carry over another in the process of distillation, as referred to in my answer to Cross-question 150.

X Q. 155. I understand you to mean that the vapors of many substances will, at heats far below their boiling-points, diffuse into other gases or vapors, as water, at, say 90° F., will rise in vapor, and diffuse itself into common air, and will be deposited again as liquid water when that air is cooled again, to, say 40° F. Is this your meaning?

A. I mean that when two substances are heated together for distillation, one of which boils at a much lower temperature than the
725 other, that when the one of lowest temperature of ebullition begins to boil, that the vapor thus formed will carry over the other substance, although its point of ebullition is much higher.

X Q. 156. Bearing in mind the fact that all commercial palm-oil contains free fat acid, do you find in Ex. 12 any positive proof that Scharling obtained glycerine, knowing it to be such, from his distillation of palm-oil?

A. I consider that we have positive proof of that fact in Scharling's statement in the following sentence, after having experimented with palm-oil, castor-oil, and tallow, and obtaining fat acid without the formation of erolein. Scharling says: "After it was thus determined that various glycerides, though with unequal facility, might be decomposed simply by superheated steam in like manner as by strong bases, I proceeded to try (prove) the operation of superheated steam upon whale-oil, dolphin-oil, and wax;" and, as I know that the decomposition of fats by the strong bases results in the formation of glycerine, I consider the above as positive proof that Scharling did produce glycerine by the action of superheated steam on fats.

X Q. 157. In Cross-question 156 you were asked, not what you now suppose Scharling to have produced, but what the exhibit itself shows Scharling to have recognized and described as his product. I therefore now ask you to quote, in the words of the exhibit, any passage in which Scharling plainly and intelligibly announces that he obtained glycerine as a product.

A. What I state in my last answer is not what I now suppose, but would authorize me, or any other chemist, to assert that Scharling obtained glycerine; that he purified it for the vats, there is no evidence of his having done. I consider that he sets that forth in the paragraph commencing with "In all these distillations" and on to "dolphin-oil and wax," these words embracing all that he sets forth on the subject.

X Q. 158. Who first made and published the specific announcement that glycerine, (naming it,) as well as free fat acids, was a product of the distillation of neutral fats by steam?

A. Dubrunfaut was the first that I know of who made the specific announcement that glycerine (naming it) was a product of the distillation of neutral fats by steam. In the patent taken out the 17th
726 of September, 1841, we find the following words, (page 495, January Reports Paris Exhibition, 1855:) "La distillation élimine ainsi tout l'acide gras que l'huile peut produire, et il reste dans la chaudière un résidu noûatu sirupeux au visqueux qui ne parait étae que de la glycerine ou un produit altéré de cette matiére." Translation: "The distillation thus eliminated all the fat acids that the oil could produce, and there remained in the still a black, syrupy, viscous residue, which appeared to be only glycerine, or an altered product of this substance." This, to the best of my knowledge, is the first place where I know that glycerine is mentioned by name in connection with the products of the decomposition of the fats by steam. That it was a well-recognized fact that superheated steam would decompose fats into fat acids and glycerine, is shown by a passage in Payen's Pieces de Chenue Industrielle, 1851; where, referring to the distillation of fat acids formed by the sulphuric acid saponification, he announces that any small portions of fat that had escaped the sulphuric acid saponification would be transformed by the current of steam into fat acids and glycerine. (See Payen's 2d ed., 771.)

(Complainant's counsel gives notice that he objects to the printed Exhibit No. 8, contained in defendants' book of exhibits, being used and read at the hearing, as said Exh. No. 8 is imperfect and incomplete, and gives an incorrect idea of the process which it professes to describe.)

X Q. 160. Is the "black, syrupy, viscous residue," mentioned by Dubrunfaut, in 1841, the same chemical substance known as glycerine in 1854?

A. I shall say, from the statements of Dubrunfaut, referred to in the last question, that it was glycerine, more or less impure, and might have been purified by processes now in use for purifying the impure glycerine arising from other methods of saponification.

X Q. 161. This black residue of Dubrunfaut was left in the still after the fat acid had been distilled off at a temperature of 330° Cent., or 626° Fah., was it not?

A. The fat distilled in Dubrunfaut's process was heated to 626° Fah. The temperature of the steam, however, used by him, is not given in the portion of the patent now before me.

X Q. 162. Please look at Dubrunfaut's patent, agreed extract,
727 (Def't's Exhibit No. 4, Tilghman vs. Mitchell,) and say whether it

does not expressly mention that the steam is heated to from 200° to 330° C., or 392° to 626° Fahr.

A. My previous statement was based on an extract of a portion of the patent as contained in the Paris jury report for 1855, page 495. The patent itself permits all ranges of temperature from 392° Fahr. to 626° Fahr., for heating the fat, and the extract to which reference is made in this last question, and to which my attention is specifically called, quotes a part of the patent, where it is said that the steam is heated from 392° to 626° Fahr., so that, in Dubrunfaut's process, the ranges of operation in the patent were: Fat heated to 392° Fahr., with steam at 392° Fahr., to fat heated to 626°, and steam heated to 626° Fahr.

X Q. 163. I read from Watt's Dictionary of Chemistry, London, 1866, vol. 2, p. 887: "Glycerine, concentrated as much as possible by evaporation, is an uncrystallizable, syrupy, liquid, colorless, inodorous, sweet to the taste, neutral to test paper. Its specific gravity is 1.260 at 15.5 C., (60° Fahr.,) when it is distilled per se, only a small portion passes off undecomposed, but in an atmosphere of steam it distills without decomposition." Please state particularly what are the properties of the "black, syrupy, viscous residue" of Dubrunfaut, by which you recognize it to be the same chemical substance as "glycerine?"

A. First. Dubrunfaut's statement that it appeared to be glycerine or an altered product of this substance. Secondly. That, in my experiments with glycerine, I have frequently evaporated the glycerine liquor from the saponification of fats, and obtained a thick, black, syrupy mass, which, when purified by animal charcoal and other means, furnished me with a white liquor having all the properties of pure glycerine. Dubrunfaut, however, gives no details of the properties of the substance he referred to as glycerine, simply alluding to it as "a black, syrupy, or viscous residue," but, when I consider that this product of Dubrunfaut was obtained from fats, I see no reason for changing my opinion already given of its containing more or less glycerine.

X Q. 164. I understood you, then, to say that, from your knowledge and research in this branch of chemistry, you believe that, when
728 neutral fats are distilled with steam at a temperature of from 392° Fahr. to 626° Fahr., the free fat acids will be distilled over, and the glycerine will be left behind in the still as a "black, syrupy, viscous residue." Is that your belief?

A. No, you are not to understand that; for I suppose in Dubrunfaut's process glycerine must have gone over with the fat acids. I only state that, in the residue he observed, he was doubtless correct in saying that it may have been "glycerine or an altered product of this substance."

X Q. 165. To the best of your chemical knowledge and belief, when neutral fats are distilled with steam at temperatures from 392° to 662° Fahr., does the glycerine remain behind in the still as a residue at the end of the operation, or does it distill over with the fat acids?

A. I have never experimented with this method of distillation, and we have but little in scientific works that is very definite on this subject; yet I can very well imagine that, for the greater part of the range of temperature above stated, a portion of the glycerine might certainly remain behind.

X Q. 166. At which portion of the range of temperature would the glycerine remain behind in distillation by steam?

A. This I cannot answer precisely, but suppose that, at a temperature at least as high as 550° Fahr., *that* a portion of the glycerine might remain behind in the operation as performed by Dubrunfaut.

X Q. 167. When and by whom was glycerine first obtained as a commercial product by the process of distillation of neutral fats by steam?

A. I believe it was obtained as an article of commerce with the above process by Price & Co.'s factory, in England, in July, 1854, according to Wilson & Payne's patent.

X Q. 168. Does any one of the technical works which refer to Dubrunfaut's patent mention glycerine as one of the useful products of his process?

A. None that I know of.

X Q. 169. Are not Wilson & Payne mentioned as the authors of this process in the reports of the English and French juries, and in all the technical works you have seen on the subject?

A. So far as I know, Wilson & Payne are mentioned as the first individuals who had obtained both fat acids and glycerine as articles of commerce by the action of steam on neutral fats.

729 X Q. 170. Has it been known to chemists since the time of Chevreul, 1823, that neutral fats will form soaps with the alkaline carbonates (of potash and soda) by long boiling at 212° F.?

A. Chevreul I believe to have been the first person to show that boiling fats and a solution of carbonate of potash would result, after a long continued action, in the formation of soap, and what is true of the carbonate of potash is equally true of the carbonate of soda. The proportions of fats and carbonate of potash employed by Chevreul were one part of fat and two of crystallized carbonate of potash.

X Q. 171. You have stated in answer to Question 12, in-chief, that in your view the temperature of complainant's process as patented is confined within certain limits, viz, between 440° Fahr. and 660° Fahr. Please state whether in your opinion the chemical process is the same or different at 440° and at 660° Fahr.?

A. I should suppose that it was the same, differing in degree, however.

X Q. 172. Please explain more precisely what you mean by "differing in degree."

A. What I mean is degree of intensity and consequently in rapidity of operation.

X Q. 173. You understand, then, from complainant's patent, that the chemical action of the water on the fats in producing fat acids and solution of glycerine is the same as 660° Fahr. as at 440° Fahr., but requires a longer time at the lower heat. Is that so?

A. In complainant's process, so far as the theory of it is concerned, I believe the heat is the primary agent in bringing about the result, the water being secondary in its action. With this view of the subject, the temperatures above referred to would differ essentially in the longer or shorter time of accomplishing the result; with this difference, however, without excessive care in the management of the process acroleine might be formed in smaller or larger quantities when the higher temperatures are used.

X Q. 174. At what degree of heat below 440° Fahr. would any change occur in the chemical action involved other than that of requiring longer time of operation?

A. This I cannot answer fully; in regard to such fats as are
730 used in candle-making, I have experimented at 320° Far., and decomposed one-tenth of the fat in eight hours.

X Q. 175. Did you ever see Wilson & Payne's process for distilling free fat acids and glycerine from neutral fats by steam?

A. I have seen the apparatus and the operation going on in Price and

Co.'s factory; at least what Mr. Wilson pointed out to me as the apparatus when on a visit to the factory. I did not examine it critically, for I knew that it was a process that they surrounded with a certain amount of secrecy at the time of my visit.

X Q. 176. How long did it take to distill off a charge of neutral fat into fat acids and glycerine?

A. That I do not know; if I were told at the time, I have forgotten.

X Q. 177. Do you know or did you ever hear of any other factory than Price & Co., London, where this process is practically carried on?

A. I have never heard of any.

X Q. 178. What is the lowest limit of temperature at which that process is practically carried on?

A. I do not know the lowest temperature at which Wilson operates.

X Q. 179. Please describe the physical condition of the fat, water, and lime, and also of the fat and water alone, as they came out of the tubes, in your experiments made in the paraffine bath, as described in your answer to Question 12 in-chief.

A. I took them out, of course, when cold, and can only describe them in that condition. The first was a soft, homogeneous, whitish mass intermingled with matter; the latter was quite like fat floating on the surface of water, whitish, soft, and opaque.

X Q. 180. In your answer to Cross-question 34 you say that there is a physical difference between defendants' product from their digester, and a mixture of neutral lime-soap and free fat acids, in that the first is transparent, and the latter opaque, with the neutral lime-soap diffused through. Please state whether the latter will not also be transparent, if it be heated so that the neutral lime-soap becomes dissolved in the free fat acids.

A. It is possible that it may be so after heating together for some time the fat acid and lime-soap, but in this case there may be formed an acid lime-soap.

731 X Q. 180½. Does not the theory of Pelouze, as to the chemical action in DeMilly's process, rest upon the assumption that water at a temperature of 150° to 160° Cent. (302° to 320° Fahr.) can decompose a neutral soap into an acid soap, and a very basic soap?

A. That is Pelouze's theory, as he states it in his article describing the reaction.

X Q. 181. Do you adopt Pelouze's theory, as your explanation of the chemical action which takes place in defendants' process?

A. In regard to this question, I have only to answer what was stated by me, in answer to Question-in-chief 12, where I stated that "as regards my theoretical opinion of the operation in defendants' process, etc.," giving my reason then for my unwillingness to enter upon a theoretical consideration of the subject without more light from my own experiments and those of others.

X Q. 182. In your answer to Cross-question 72, you say "in DeMilly's process I believe that the water used is capable at a high temperature of liberating free fat acid from the acid lime-soap first formed. In your answer to cross-question 60, you say that DeMilly's process is substantially the same as defendants' processes. In your last answer and the prior answer referred to in it, you say you are unwilling to form any theory upon the subject. Please say which of these two answers you wish to be retained as the expression of your fixed and deliberate opinion.

A. If the plaintiff's counsel will examine carefully my answer to the last question, and the answers to Cross-questions 72 and 60, to which he refers, he will find that there is no connection between the answer to last question and the Cross-questions 72 and 60; for the last answer is in relation to Pelouze's theory of the action of water on a neutral lime-soap, and my previous answers refer to acid lime-soap.

X Q. 183. I understand then, as the result of your deliberate consideration of the subject, that you decline to offer any definite and positive explanation or theory of the chemical action which takes place in defendants' processes; is that so?

A. You are to understand that I have nothing further to add on this subject than what was stated in answer to Question-in-
732 chief 12, where I state that "as regards the respective part that each agent of decomposition plays, I do not believe that any chemist can give a reliable explanation in our present state of knowledge," &c.

X Q. 184. If DeMilly's process was worked at a temperature 100° Fahr. higher than those named in his English patent, would it then become a different chemical process?

A. In theoretical chemistry it would not; in technical chemistry it would.

X Q. 185. Would the chemical actions involved remain the same at the different temperatures named?

A. The chemical action would doubtless be the same, with this difference, that the increased temperature would cause a more rapid result.

X Q. 186. Did you ever perform the operation of distilling fat acids with steam?

A. Never.

X Q. 187. Do you, or do you not, know that in all processes of distillation by steam, either of neutral fats or of fat acids, a black, viscid residue is always left in the still?

A. I know nothing as to the residue in the distillation of neutral fats by steam, if there be any; as to the fat acids (as they are made by the decomposition of fats by sulphuric acid,) I do know that there is a thick, black, viscid residue, that results from the decomposing action of the sulphuric acid, and upon certain constituents of the fats.

X Q. 188. In DeMilly's process, as you have seen it worked or described, was superheated steam used?

A. The steam was passed directly from a boiler, at a high temperature, into the digester—passed between the boiler and digester through heated tubes.

X Q. 189. Will the action of heat alone, without water or steam, upon neutral fats, give glycerine as a product, or will it destroy the glycerine?

A. It will destroy the glycerine at a temperature that will decompose fats.

X Q. 190. Is this process used in practice for manufacturing fat acids?

A. A patent (at an early period) was taken out for the manufac-
733 ture of fat acid by this process, but is was only used to a limited extent, as far as I can learn; for less disagreeable and more economical processes were adopted. (Moses Poole's patent, June 9th, 1825, in England.)

X Q. 191. In defendant's processes, are the fat acids distilled?

A. They are not.

X Q. 192. In defendant's processes, is the presence of water at a high

temperature and pressure (about 75 to 85 pounds per square inch, and about 320° Fahr.) necessary.

A. It is; because you could not treat properly the fat with the lime without it, as the water is required to make a milk of lime, such as is introduced into the digester.

X Q. 193. In your answer to Cross-question 72, you say, "in DeMilly's process I believe that the water used is capable, at a high temperature, of liberating free fat acid from the acid lime-soap first formed." Please state upon what facts or experiments of your own or other persons you base this belief.

A. I have none but those stated in answer to Cross-question 72.

X Q. 194. In the process of Dubrunfaut (Deft's Ex. No. 8) or in that of Scharling (Deft's Ex. No. 12,) or in that of Payen (Deft's Ex. No. 8,) is any liquid water, at a high temperature and pressure, present, mixed with the fat, during the operation?

A. There would appear to be no water present in a liquid form.

X Q. 195. Could the processes of defendants or of complainant be operated in the distillatory apparatus of Dubrunfaut, or of Scharling, or of Payen, referred to in Cross-question 194, or could either of the three last-named processes be operated in the apparatus of defendants or complainant?

A. The processes of both the complainant and defendants are different from the above, and could not be performed in the above apparatus, for both the complainant and defendants call for closed digester, while the stills of Dubrunfaut and Scharling have open communication with the atmosphere.

X Q. 196. As a matter of chemical history and record, did chemists generally become informed from the publication of Faraday's paper (Deft's Ex. 1) of the fact that fats could be decomposed into free fat acids and solution of glycerine by the action of water at a high temperature and pressure?

734 A. So far as my information goes, chemists generally seem to have paid but little attention to Faraday's paper, and consequently could not have become acquainted with the fact referred to.

X Q. 197. Can you testify that you have ever seen any publication, of date earlier than January 9, 1854, in which it is explicitly mentioned that fats can be decomposed into free fat acids and glycerine by the action of liquid water at a high temperature and pressure?

A. I cannot testify that I have seen any publication earlier than January 9, 1854, in which it is explicitly mentioned that fat acids and glycerine can be produced in the manner referred to.

X Q. 198. Can you testify that you have ever seen any publication of date earlier than January 9, 1854, in which it is explicitly mentioned that fats can be decomposed into free fat acids and glycerine, or into acid-soaps and glycerine, by the use of a quantity of alkali less than the chemical equivalent, in connection with liquid water at a high temperature and pressure? Please answer directly, yes or no.

A. No.

X Q. 199. Are you now a partner or agent of M. DeMilly in the United States patent for a process for manufacturing fat acids, where sulphuric acid is used, referred to by you as Process No. 7, in your answer to Question 7 in-chief?

A. I am. The process, however, is entirely different in all respects from the one that has been under consideration in these interrogations.

Re-examination by counsel for defendant:

Q. 200. Is the process referred to in the last preceding question and answer in use anywhere in the United States?

A. It is not.

Q. 201. In such process, what becomes of the glycerine of the fat?

A. A portion of it is altered; doubtless the greater part of it combines with the sulphuric acid to form sulpho-glycerine acid, which is washed out from the products of decomposition, and ultimately thrown away.

735 Q. 202. From the time of Gay-Lussac and Chevreul to the present time, has not glycerine been a product of the decomposition of fats by the action of alkalies, whether the process was conducted in open vessels or in closed vessels under pressure?

A. It has been.

Q. 203. In all processes where lime is used is not a portion of lime found in the glycerine solution, and is not the quantity of lime found in the glycerine solution the same, whether the percentage of lime employed is great or small?

A. In all processes where the lime is used, a portion of it is found in the glycerine solution; whether the proportions are the same under the two conditions referred to in the last part of the question, I cannot say.

Q. 204. Is not glycerine largely produced, as an article of commerce, from the saponification of fats, where lime is employed in quantity sufficient to make neutral soaps of all the acids of the fat?

A. It is.

Q. 205. What is its quality as compared with that produced from any other process with which you are acquainted?

A. I have seen the glycerine produced by the different processes, and, so far as I know, the quality is equally good, as made by the different methods, when the same descriptien and quality of fats are used.

Q. 206. Have you made any experiments with the process of the complainant as described in his patent, so as to be able to say that the glycerine of fats will not be destroyed at the temperatures and with the proportions of water specified in said patent?

A. I have not made any such experiments, and cannot say anything about it one way or the other.

J. LAWRENCE SMITH.

736 Examination of Edward S. Wayne, by Cha's B. Collier, esq., counsel for the defendants, Monday, June 28th, 1869, 10 a. m. Present, B. C. Tilghman, esq., counsel for the complainant, and Cha's B. Collier, esq., counsel for the defendants.

EDWARD S. WAYNE, being first duly cautioned and solemnly sworn, deposes and says as follows.

Q. 1. State your age, your place of residence, and your occupation.

A. I am about 49 years of age. I reside in Cincinnati. My occupation is that of a chemist, and I might add druggist. I have been engaged practically and theoretically for the last thirty years in chemistry. I have been professor of chemistry in the Ohio Medical College in this city, and professor of pharmacy and chemistry in the Cincinnati College of Pharmacy. I am now a member of the firm of F. E. Suire and Company, in this city.

Q. 2. Have you investigated theoretically and practically the various methods employed for the decomposition of fats, and the production

therefrom of fat acids and glycerine? If yea, to what extent has your attention been given to such branch of industrial chemistry?

A. I have given attention to this subject for many years; I may say as far back as twenty-five years ago, in connection with Campbell Moffit. I believe I am generally acquainted with most of the processes for the manufacture of fat acids and glycerine *are* and have worked them practically and experimentally.

Q. 3. Have you read the specification of the letters-patent issued to the complainant in this case, Richard A. Tilghman, dated October 3d, 1854, No. 11766; and do you understand the nature of the "improvement in processes for purifying fatty bodies" described and claimed therein?

A. I have read the letters-patent, and will say that I understand them.

737 Q. 4. Have you read the description of the processes of the defendants in this suit, as contained in their original and supplementary answers, and have you seen such processes as practically conducted at their manufactory in this city? And if yea, do you understand such processes?

A. I have read their description as contained in the answer, I have witnessed the operations on a practical scale, and have conducted them myself at their factory. I understand the processes.

Q. 5. Having read, and understanding, as you state, the letters-patent of the complainant, and having conducted, and understanding, as you also state, the processes of the defendants as described in their answers, will you please state whether or not, in your opinion, the said processes of the defendants are, or whether either of them is substantially the same in principle, mode of operation, and results produced, as the process described and claimed in the complainant's said patent; and if in your opinion the defendants' said processes differ in principle, mode of operation, and results produced, from the process of the complainant, will you please specify the particulars of such differences?

A. I am fully satisfied that the letters-patent of the complainant, that his process as therein described, is distinctly different from those of defendants; for in the complainant's process, as described in the letters-patent, he names and specifies conditions and limits of heat that have no parallel in the other, describes a different apparatus, and as a final result of the operation produces different results, namely, free fat acids and solution of glycerine. In the complainant's process high heat, great pressure, and water are used as agents in the decomposition of the fat into fat acids and glycerine; and the apparatus specified and figured particularly is that of a continuous coil of great strength, capable of withstanding many pounds pressure, and the limit not to exceed 2,000 pounds to the square inch, and further states that the temperature necessary for the accomplishment of the decomposition to be between that of 660° Fahr. and 510° Fahr., further states he has found the melting point of lead, 612° Fahr., as a proper heat, because it has given good results, but remarks that some fats, such as palm-oil, the decomposition

738 may be effected at a lower temperature, (at the fusing point of bismuth, 510° Fahr.) Again in the original application of the patentee for letters-patent for the production of soap, he states that with the mixture of the alkaline, carbonate, fat and water, saponification takes place at lower temperature. The degree of heat required is less than that which is necessary to produce free fat acids, and should generally be kept between the melting points of tin and bismuth. At or about 350° Fahr. the neutral fats will form soaps with the alkaline car-

bonates, but a higher temperature will produce the results more quickly. I can, then, from these facts and temperature named, come only to the conclusion that the degree of heat the complainant considered necessary, and specified in his patent as a necessary and proper heat to be used, to be between the melting point of bismuth, 510° Fahr., and 660° Fahr., the melting point of nitrate of potash; and also that he deemed an intermediate point, 612° Fahr., the melting point of lead, to be about the proper heat for c ..rying out his process.

That such was the intent is plain to me from the care with which the use of higher heat than the melting point of lead is spoken of, and in the same connection that the decomposing power of water becomes more powerful as the heat is increased, and that a coil, or other suitable apparatus, capable of withstanding a pressure of 2,000 pounds the square inch, the apparatus to be used, and that he believed the coil apparatus the best mode of carrying out the process, and the one he used.

And, as before mentioned, the final result of the operation is the production of free fat acids and glycerine; no lime-soap produced, consequently no acid required to decompose it, or used in the process. Now the defendant's process I consider as distinctly different as it is possible for two chemical processes to be. The apparatus also is different, in kind and detail. It is also different in the operation of decomposing the fats into fat acids and glycerine by the use of less heat and pressure, by the use of an auxiliary base, lime, as an agent in the decomposition, and the final result of the process, not being free fat acids and glycerine, but lime-soap of the fat acids, fat acids combined with lime-soap requiring another chemical process to free them from the lime and glycerine in solution with lime.

Thus the process, agents used, and final results are not the same. I
am convinced of this from experiments I have made at the factory
739 of the defendants; also from the fact published on the saponification of fatty matters by means of "soap" by Pelouze, and of the saponification of fats by a quantity of lime less than necessary to form neutral soaps, by De Milly, which experiments I have repeated and confirmed, which processes, in standard works on chemistry, such as Watts' Dictionary of Chemistry, Miller's Chemistry, the London Chemical Gazette, and Morfitt, are mentioned and considered as a distinct and novel process from that of complainant; also from the experiment of Scharling, Dubrunfaut, Wilson and Payne's process, and others.

From the experiments I have made upon large quantities of fats at the factories of M. Werk and Company and George Shillito, I am fully satisfied as to the correctness of my opinion of the difference between the two processes, irrespective of the difference of results. For instance, at the factory of M. Werk and Company I treated 7,000 pounds of tallow, about 4,500 pounds of water being the usual quantity they used, and in the tank used by them for the manufacture of fat acids. This tallow was treated exactly as was their usual method, for eight hours in their tank, with a safety-valve attached to it. Superheated steam was, during the operation, passed into the tank, the steam issuing from a boiler at a pressure ranging from 85 to 90 pounds during the whole time, the safety-valve of the tank being so loaded that there was a constant current of steam issuing from it during the greater part of the operation, or as soon as the fatty matter became heated to the boiling point of the water due to the pressure. At the expiration of the eight hours a specimen of the fatty matter was taken from the tank, and an analysis made of it by me.

The result of the analysis showed that a decomposition of the fatty

matter had taken place to the extent of 7.23 per cent. In other words, 7.23 per cent. of fat acids were produced. This experiment was made March 3d, 1869. A duplicate of the experiment was made by myself and Prof. J. Lawrence Smith, of Louisville. A specimen of the fat after the operation was finished I also analyzed, and found that decomposition of the fatty matter into fatty acids had taken place to the extent of 11.35 per cent. The proportions of fat and water, and the heat, time, and pressure in this last-mentioned experiment were the same as in the first-mentioned experiment at Werk and Company's factory. I have also performed an operation upon 7,000 pounds of fat, 4 per cent. of lime, and about
740 4,500 pounds of water, the usual working proportions, the same heat and pressure and time of operation as in the last-mentioned experiments.

An analysis made by me showed the whole of the fat to be converted into lime-soap, fat acids, and glycerine. I have also repeated Pelouze's experiments of the saponification of fats by the means of lime-soap. The mixture of lime-soap, fat, and water, was heated to about the temperature of 315 to 328° Fah. for three hours, and at the same time fat and water alone were heated for the same time, and to the same temperature. Both were heated in the same bath.

Upon the examination of the results of two experiments conducted in a similar manner, I found that the fat with the lime-soap and water had become decomposed, in one experiment to the extent of 60.15 per cent., and in the second experiment to the extent of 58.56 per cent., and that the fat heated with water alone exhibited no trace of decomposition.

I am of the opinion that the liquid water in Tilghman's process is of itself of no value beyond furnishing the elements of water for the decomposition, and that heat alone is the agent causing the decomposition of the fats by water; and the pressure he claims and uses is the only way to obtain the heat necessary for this decomposition. The water is only necessary so far as it furnishes the elements of water in chemical equivalent to the fat to form respectively fat acids and glycerine. Steam in its chemical relations in this decomposition is equivalent and identical with water. This is proven by the fact of the decomposition of the fat mentioned as occurring in the Perkins' engine, by Charling's experiments, by Wilson and Payne, and others. All that steam requires is the same temperature. This is given to it by superheating it to the point necessary for the decomposition. Fat acids and glycerine is the result. Could water be heated without pressure to the temperature necessary for the decomposing of fatty bodies, the same result would follow as with the use of pressure, namely, fat acids and glycerine.

Hence I can perceive that there is no new discovery of the decomposition of fatty matters by the agency of water alone, and conceive the facts in relation to it have been known, mentioned, and experimented with prior to the complainant's patent. Water and steam for the
741 decomposition of fats require a high temperature, and the higher the temperature the more rapid the decomposition; but the introduction of another agent in the decomposition, such as an alkali, or water containing a small percentage of sulphuric or sulphurous acid, or neutral lime-soap, the decomposition of fats into fat acid and glycerine will take place at a much lower temperature than can be effected by steam or water alone. This fact I have proven satisfactorily to myself, by experiments named of treating fat and water; fat, water, and lime; fat, lime-soap, and water, to the same temperature of 325 to 330° Fahr. With water alone there was none, or only a small percentage of fat acid produced; with lime, a total decomposition, and with lime-soap nearly

60 per cent. With these results, I can but say that the effect of lime and soap in small quantities, less than necessary to produce neutral lime soaps, is to facilitate the decomposition of fats, and bring about that change at a lower temperature than highly-heated water, or highly-heated steam can produce the same results. And that there is a wide, distinctive difference in consequence between the processes of complainant and defendants. And further, that steam and water at the same temperatures possess equal decomposing power, and the only use in the process of liquid water in decomposing fats into fat acids and glycerine, is as a carrier of heat; and as water only so far as it is required to free fat acids and glycerine. The lime, as I have said, facilitates the decomposition of the fats, and I am satisfied that it acts an important part throughout and to the end of the decomposition, and not merely to its simple combining equivalent with the fat acids.

It is a well-known fact to chemists that many substances in small quantities exert a powerful influence in the decomposition of other bodies. We may conceive the small quantity of lime used by the defendants thus to act, and can but quote the language of the complainants to this point.

In a paper published in Silliman's Journal, published May, 1848, vol. 5, page 267, he mentions "lime, magnesia, and particularly alumina, were found to aid materially by their presence in the decomposition of sulphates and the chlorides of potash." The lime used by the defendants, then, like the small addition of lime, magnesia, or alumina, in the decomposition of sulphates and chlorides of potassium at a high heat, with superheated steam, as described by Mr. Tilghman in his
742 paper in Silliman's Journal, materially aids the water and steam in the decomposition of fats, and causes this change at a lower temperature than if it was not used.

Steam alone, in an open vessel, will decompose fats. That the presence of moisture will decompose fats at ordinary temperature has long been known, and the rancidity of fats is nothing but this change into fat acids and glycerine. Now, then, it has been known that moisture or water at ordinary temperatures will slowly decompose fats, more rapidly by heating them to their melting point with water, still more so by an addition of an alkali sufficient to form soap with the fat acid, and with less alkali, than would form a neutral soap at a still higher temperature; and by water or steam at a still higher temperature rapid and complete saponification would take place. Steam, in every respect, I consider as equivalent and identical in its decomposition of the fats. This latter point I do not consider original with complainant, as it has been observed, written, and experimented upon, and used prior to the date of complainant's patent.

Q. 6. Will you please state what is the appearance and properties of the fatty product as it comes from the defendants' digester, and whether or not the same could be applied to any useful purpose by being first submitted to any mechanical treatment?

A. It is a difficult matter to describe intelligibly the products. It has not the appearance of fatty matter. It is of a whitish appearance, thick consistency, somewhat like mortar, and it is an intimate mixture of lime-soap dissolved in fatty acids, glycerine, and water. It could not be applied to any useful purpose by any mechanical application.

Q. 7. Has it the crystaline appearance and structure of free fat acids?

A. It has not the crystaline appearance of fat acids. It is granular.

Q. 8. Have you submitted such fatty product to mechanical pressure? If yea, what was the result thereof?

A. I have submitted the same to mechanical pressure, confined in cloths; but could produce no separation. From the nature and condition of the substance, it wormed through the cloth; consequently no separation could be made.

743 Q. 9. Do you know whether or not, after treatment of defendants' product by sulphuric acid, according to their usual method, lime is still found in the product of such treatment?

A. I do. Lime is still present in their product after treatment by sulphuric acid.

Q. 10. In the production of free fat acids and solution of glycerine by steam or by water alone, where, at the conclusion of the operation, will the free fat acid product be found; above or below the glycerine solution?

A. In a tank the free fat acid will rest upon the surface of the water.

Q. 11. In the defendants' product, is the lime blended throughout the entire mass of the fatty product?

A. It is.

X Q. 12. Does any portion of fat acids separate from the glycerine solution and from the soap by subsidence?

A. There does not.

Q. 13. In the complainant's patent it is stated as follows: "I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting point of lead, until the operation is complete." What would be the effect of heating the materials in the defendants' digester to the "melting point of lead?" In other words, what do you say as to the possibility of complying in their digester with this provision of the complainant's specification?

A. I consider it utterly impossible. The apparatus would not be capable of resisting a pressure corresponding to that degree of temperature.

Q. 14. Supposing the pressure corresponding to that degree of temperature to be, say, 1,500 pounds to the square inch, will you please state the difference between such pressure and the pressure which could be safely maintained in defendants' digester?

A. I do not think that a pressure above 150 pounds to the inch could be used with safety in the apparatus of the defendants. One already has exploded, with a loss of life and property, at the ordinary working pressure, between eighty and ninety pounds on the steam-generating boiler supplying the tank.

744 Q. 15. In his description of the "convenient vessel" contemplated by the complainant, he further, in his patent states: "The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam." Is the digester of the defendants so closed as described in the complainant's patent?

A. The digester of the defendants is not so closed. Oil has a vent through a safety-valve. Steam is issuing from the same from the time that the water and fat are heated up to the boiling point of the water (at the pressure employed) until the end of the operation. There is a free flow of steam; not only that issuing from the boiler, but that resulting from the evaporation of a portion of the water originally placed in the digester.

Q. 16. Without reference to the character of the defendants' product, chemically or commercially considered, and whether it be acid, lime-soap, or free fat acids and neutral lime-soap, is it your opinion that any portion of such product is produced by the sole action of water, or is

its production the result of the combined power of the different agents employed, to wit, water, steam, heat, and lime?

A. I would say that no portion of the fat acids is produced by the sole agency of water, but the fat acids are produced by the combined agency of the lime, heat, and water, acting simultaneously and to the end of the process.

Q. 17. Is it your opinion that the lime and the steam act upon the fat from the beginning to the end of the process?

A. It is. And I consider the water used merely to facilitate mechanically the decomposition.

Q. 18. Will you look at the paper now produced and hereto attached, marked "Defendants' Exhibit No. 1, Wayne," and state what the same is?

A. It is a report of experiments made by myself and A. Fennell to determine the decomposition of natural fats into fat acids and glycerine by the agency of water, and also by the agency of lime-soap and water, both exposed to a temperature of about 320° Fahr. The temperatures during the experiment ranged from 311° to 328° Fahr. The results of the experiments are stated in the report, and the manner in which they were conducted.

745 DEFENDANTS' EXHIBIT—"WAYNE," NO. 1.

Report of experiments made by E. S. Wayne and A. Fennel, to determine the decomposition of neutral fat into fat acids and glycerine by the agency of water, and also by the agency of lime-soap and water, both exposed to a temperature of 320° *Fahrenheit.*

FIRST—FAT USED.

For the purpose of determining the above-mentioned decompositions, we have selected tallow as the fat to be operated upon, it being the article now commonly used by candle-makers. The tallow we obtained by rendering fresh beef-kidney suet; and, before submitting to the experiment of decomposition, first tested it as to its solubility in alcohol, by boiling it with it, allowing the solution to cool, and then evaporating the filtered solution. We found that alcohol of 94° dissolved 0.98 grains of tallow, or that cold alcohol, of the strength mentioned, 0.98 grains of the fat to the fluid ounce, and boiling hot held 7.64 grains fat.

SECOND—THE DIGESTER.

The apparatus used for the experiments were two copper-tubes, with brass ends, one removable, and fastened by means of a screw cut in it. The tubes were one and one-fourth inches in diameter and six inches in length.

THIRD—QUANTITY OF FAT USED IN EXPERIMENTS.

We have made duplicate experiments of both, i. e., of water and fat, and water, lime-soap, and fat. With one experiment, with water and fat, we used 240 grains of fat, and water sufficient to nearly fill the tube. The second we mixed, or incorporated to a paste, the fat and water with charcoal (purified) for the purpose of holding or bringing the fat and water more closely into contact, if possible, and favor its decomposing effect upon the fat.

With lime-soap, fat, and water, in one experiment, we used 240 grains of fat and 305 grains of lime-soap; in the second equal quantities of lime-soap, fat, with water.

746 FOURTH—LIME-SOAP USED.

The lime-soap used in the experiments was made by dissolving white soap in water, and decomposing it by a solution of chloride of calcium, the precipitated lime-soap collected on a filter, perfectly washed, and then dried.

FIFTH—BATH USED FOR HEATING TO 320°.

A paraffine bath was used, having a thermometer placed in it to record the temperature.

SIXTH—EXPERIMENT AND RESULTS.

The tubes were both placed in the same bath when it had obtained a temperature of 290°. In thirty-five minutes after being placed, the thermometer indicated a temperature of 315°. The bath was kept at this temperature as near as possible, the variations of it ranging from 311° to 328°—the latter degree for only a few minutes. The tubes were kept in the bath, during the first experiment, three hours and thirty-five minutes, then taken out and cooled. In the second experiment, the tubes were placed in the bath at a temperature of 290°; in fifteen minutes after, the temperature was 310, and the tubes were from this time kept three hours in the bath, the temperature varying during the time from 310° to 320° Fahr.

SEVENTH—EXAMINATION OF RESULTS.

The tubes, after cooling, were opened, and the contents removed, and a portion of the contents of each were examined by us, each separately examining his portion and reporting the result of his analyses.

FAT AND WATER.

The water that was heated with the fat was evaporated; it left only a trace of gummy matter. And the fat treated with boiling alcohol, and the solution filtered from the same, upon evaporating, gave the following amounts of fatty matter, soluble in one ounce of boiling alcohol: Wayne 10.35 grains; Fennel, 9.85 grains. Upon examinations of this, we find it to give traces of fat acids only.

FAT, LIME-SOAP, AND WATER.

747 We found, upon analysis of the above, that a much greater decomposition had taken place in the fat, as follows, than with water alone:

First experiment—Wayne—fat acids	60.15	per cent.
glycerine	5.07	per cent.
Fennel—fat acids	57.50	per cent.
glycerine	5.21	per cent.
Second experiment—Wayne—fat acid	58.56	per cent.
Fennel—	51.7	per cent.

CONCLUSIONS.

From the results of the above experiments, we can but say that, at the temperature with which we worked, water has but little, if any, effect in the decomposition of neutral fat into fat acids and glycerine; but that a mixture of lime-soap and water, under the same conditions, will decompose fat into fat acids and glycerine. In our experiments, all the fat was not completely decomposed, but a large portion of it; and that portion which is not so converted seems to be changed to a certain extent, as we find it to be much more soluble in alcohol than before it was submitted to the treatment. Our results also confirm the experiments and statement of Pelouze, and is, as stated by him, the saponification of fatty matter by means of soap.

(Signed) E. S. WAYNE.
(Signed) A. FENNEL.

CINCINNATI, *September* 30, 1868.

Q. 19. Have you read Defendants' Exhibit No. 1, title "Change of fat in Perkins' engine, by water, heat, and pressure?" If yea, will you please state what information, if any, you derive therefrom as to the decomposing power of water upon fats?

A. I have read the exhibit. From the product obtained, and described in the exhibit, I should say that the fact was clearly made out, of the decomposition of the fat into fat acids and glycerine.

Q. 20. Have you read, and do you understand Defendants' Exhibit No. 12, being an account of Scharling's experiments? If yea, what fact do you find there announced, and what products resulted from the process therein described?

748 A. I have read, and understand the description of the experiments. Fat acids were produced from palm-oil, castor-oil, and tallow, by passing a current of superheated steam through them at a temperature of about 160° Cent., or 320° Fahr. As there were fat acids produced by this experiment, there must also have been produced an equivalent amount of glycerine, as the decomposition of fats into fat acids cannot take place, thus treated, without the production of glycerine.

Q. 21. Is there any evidence contained in said exhibit? If so, what, that the glycerine was not destroyed?

A. There is no evidence that it was destroyed. No acrolein' is mentioned as occurring in the decompositions described.

Q. 22. Is it your opinion that the announcement subsequent to the date of said publication, (to wit, 1850,) of the decomposition of fats, by the action of water, into fat acids and glycerine, would be the announcement of a new and independent chemical discovery, different from that contained in Exhibit No. 12?

Here adjourned until 9 a. m., Tuesday, June 29, 1869.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

Met pursuant to adjournment.

A. I do not think so, for I can see no difference, as a chemical fact, between the decomposition of fats by steam and that by water; consequently, do not regard decomposition by water as a new discovery, only as a method by which the decomposition may be effected.

Q. 23. Have you read Defendants' Exhibit No. 9, title "Castor-oil, remarkable change in, on the surface of the water in the cistern of the water barometer?" If you have read said exhibit, will you please state what fact is therein announced, and what products resulted from such "change," and how such "change" in said oil was brought about?

A. I have read the exhibit. The change consisted in the conversion of the castor-oil into fatty acids and glycerine. The decomposition was effected by the agency of the water.

749 Q. 24. What degree of chemical knowledge would be required in order to know that the "change" or decomposition of oil, as spoken of in said exhibit, would be facilitated by the application to the materials of heat.

A. That is a very difficult question to answer. A chemist might be possessed of a considerable amount of chemical knowledge, yet overlook the fact, not having his attention especially directed, either accidentally or otherwise, to it, whilst another, with less knowledge, having his attention directed especially to fatty matters, might take advantage of the fact developed, and readily imagine the application of heat would facilitate the decomposition.

Q. 25. Is it not a law well understood by all chemists, and has it not been so understood for many years prior to the date of complainant's patent, that increase of heat facilitates all processes of chemical decomposition?

A. As a general thing it is.

Q. 26. Have you read, and do you understand, the letters-patent of David Walther, (Defendants' Exhibit No. 17?)

A. I have read and understand them.

Q. 27. Will you please state what, in your opinion, would be the resulting products of the process described in said patent, with the use, in connection therewith, of the same quantity of lime as is employed by the defendants in their processes; wherein, if at all, would the resulting products differ from the products of the defendants' processes?

A. I would say that the results would be almost parallel. The decomposition of the fatty matters would take place; fat acids, lime-soap, and glycerine would be produced; but as the temperatures named in the patent of Walther are lower than those used by the defendants, more time would probably be required in the decomposition.

Cross-examined by B. C. Tilghman, esq., counsel for the complainant:

X Q. 28. Were you professionally employed as a chemical expert by M. Werk, one of the present defendants, and examined by him as
750 a witness both before the hearing and before the master in the suit of R. A. Tilghman against M. Werk?

A. I was.

X Q. 29. Do you understand the process used by said M. Werk, as described in his answer, filed in said suit?

A. I do.

X Q. 30. Is the process used by said Werk, as described in said answer, substantially the same chemical process as the process described as being used by the defendants herein in their original answer, filed 1st August, 1868?

A. I consider them substantially the same chemical processes. The only difference that I perceive between the two is the introduction of sand at the end of the process described in the answer filed 1st August, 1868. The sand has no chemical effect whatever. Its action I consider merely mechanical, causing a separation of the fat acids, lime-soap, and water.

X Q. 31. Is the process described as being used by defendants herein in their supplementary answer, filed 1st December, 1868, substantially the same chemical process as the process described as being used by them in their original answer, filed 1st August, 1868?

Is not the only difference between the two processes this: that when 7 per cent. of lime is used, about 7-tenths of the fat is converted into lime-soap, and when 4 per cent. of lime is used, about 4-tenths of the fat is converted into lime-soap?

A. As chemical processes I would consider them substantially the same, namely, the decomposition of fats into fat acids and glycerine, with less percentage of lime than would form neutral lime-soap, the decomposition effected in both by the combined agency of water, lime, heat, and steam.

In regard to the difference of products, analysis by means of processes in use with chemists would actually show that seven per cent. of lime in one instance was combined with the fatty acids to form lime-soaps; in the other instance the four per cent. of lime would be in the same combination, lime-soap of the fat acids. Neutral lime-soap in either case would be the result of the analysis. But I am by no means satisfied that the lime, from the beginning to the end of the process, in the tank, is a neutral lime-soap.

751 X Q. 32. Please examine the English patent to L. A. DeMilly, No. 2740, now produced, and state whether or not the process therein described for decomposing fats with about 2 per cent. of lime, in connection with water at a high temperature and pressure, is substantially the same chemical process as the process described as being used by defendants in their supplementary answer herein.

A. I have read and understand the patent. I would say that it is substantially the same, namely, the decomposition of fats into lime-soap, fat acids, and glycerine, by the combined agency of lime, water, steam, pressure, and heat.

X Q. 33. Do you understand the process used by M. Ropes & Co., of Cincinnati, for the past eight years, by which fats are decomposed by the use of one-half per cent. of lime in connection with water at a high temperature and pressure?

(The counsel for the defendants objects to this line of examination, for the reason that the same is not cross-examination, but new matter introduced by the complainant's counsel, as to which he makes the witness his own expert, and the defendants' counsel will claim the benefit thereof.)

A. I do. I consider the process of Ropes identical with DeMilly's and defendants'. I consider all processes wherein lime, or any other alkali, may be added to the fat and water, distinct processes from that of fat and water alone; for I know by experiment, and the results of the operations of others, that the addition of lime in any sensible amount materially aids in the decomposition of fats into fat acids and glycerine, so much so that I consider it a distinct chemical process from the other named.

X Q. 34. I understand, then, that, in your opinion, the process o Ropes, or any process wherein any sensible quantity of lime or alk (even less than one-half per cent.) is used, is substantially the sa chemical process as the processes used by defendants herein, and th it is a substantially different process from that described and claimed, complainant's patent. Is that your opinion?

A. I am of the opinion that the addition of any sensible quantity alkali materially affects the decomposition of the fats; and these pr cesses are the same as those of the defendants.

It is my opinion that the process where any sensible amount of alkali is used is substantially different from that of the complainant's.

752 X Q. 35. Would the chemical effect of any "sensible amount" of alkali in the process, in addition to the water and fat, be the same in quickening the decomposition, whether said alkali was put in with that direct intention or not?

A. I would answer that question by saying I do not know why any alkali should be added unless it was to facilitate the decomposition of the fats. If added to the fats to correct any acidity that might already exist in them, I do not see the necessity for it; for the acids produced during the decomposition of the fats in the apparatus would act upon it with the same facility that any acidity existing originally in the fat would do. Again, to determine how much should be added to correct the acidity existing in the natural fats would be a nice question—to determine how much alkali it would require to neutralize them; an' if the acids were other than acetic acid, and others higher in the series than the solid fat acids, a lime-soap would be formed which would exert an influence aiding the decomposition. By a sensible quantity of lime I do not mean a mere trace. I believe the addition of lime facilitates the result.

X Q. 36. Suppose you were handed a substance, supposed to be a mixture of free fat acid and neutral lime-soap, in which these two substances were merely mechanically combined by melting, and you were requested to verify the fact that this substance was so composed; as a chemist how would you proceed to do it?

A. My process would be separation of the fat acids from the lime-soap by means of alcohol. The alcohol would dissolve out the fatty acids, with a trace of lime-soap. In the report of the analysis I should make no note of the accidental impurity in the fat acids of the lime-soap, and give the amount dissolved by the alcohol as the quantity of the fat acids found; and the difference would be the lime-soap. Ether will also dissolve fat acids. So also benzole and benzine. They will dissolve, also, neutral fats. Hence alcohol is the proper solvent for the fat acids, as it has but a slight solvent property of the neutral fats, except castor-oil.

X. 37. In thus acting you would have the sanction of chemical authorities as far as you are acquainted, would you not?

A. I believe so.

753 X Q. 38. Does the use of sulphuric acid as described in defendants' processes, set free any fat acid except that which forms a saturated lime-soap with the 7 or 4 per cent. of lime, respectively used in said processes?

A. At the end of defendants' process the result, as shown by ordinary analysis, is that of a neutral lime-soap; but I have mentioned before that I do not consider the lime to be in this condition from the beginning to the ending of the process. As a final result it is, and is dissolved in the free fat acids; the action of the sulphuric acid in the final decomposition, is that of setting free the fat acids, combined with the lime, as neutral lime-soap.

X Q. 39. Does the sulphuric acid set free any other fat acid?

A. The mixture as it issues from defendants' tank is a mixture of fat acids and lime-soap, that cannot by any possible mechanical agency be separated, except by that of absorption by an absorbent substance. To set free the fat acids, both combined with the lime, and as free acids, requires a chemical agency to accomplish it. Sulphuric acid added in sufficient quantity to decompose the lime-soap, will set both free.

X Q. 40. I understand you, then, to say that in defendants' product,

one part of the fat acid (A) already exists in a chemically free state, but this chemically free fat acid is mechanically mixed with neutral lime-soap (B); and when sulphuric acid is added to defendants' product, it takes way the lime of the lime-soap (B), and sets its fat acids chemically free, and at the same time liberates the pre-existant fat acids (A) from its state of mechanical mixture; is that your meaning?

A. It is.

X Q. 41. Please look at Exhibit "E," attached to complainant's bill herein, page 38, defendants' printed record, and state whether the analyses therein noted, as made by you, are correct analyses of M. Werk's product, as taken by you from his digester, on, or about, March 2nd, 1865?

A. They are.

X Q. 42. If you have made any analyses of the products of defendants' processes, as described in their answers herein, please state whether said products differ from the analyses in Exhibit "E," in any other respect than in containing a diminished quantity of lime or neutral lime-soap and a proportionately increased quantity of free fat acids.

754 A. I have made such analyses; their products do not differ from the analyses in Exhibit "E" in any other respect than those mentioned in the question above.

X Q. 43. What is the smallest quantity of lime that you have known to be used in any operation, experimentally or otherwise, in the digester of the defendants or of Geo. Shillito?

A. In practical operations, I believe the smallest quantity used to be 4 per cent. of good commercial lime. I have not experimented with less quantity.

X Q. 44. In the former suit, of Tilghman against Werk, did you make any examination as an expert under an order of the court, to ascertain the practicability of operating in the apparatus then used by Mr. Werk, with a quantity of lime sufficient to form neutral lime-soap, with all the fat used?

A. I did make such an examination. I believe now, as I reported then, that it is not a practicable process. At the time this experiment was tried in the defendants' tank, a revolving stirrer was used; we had great difficulty in the use of it, in consequence of the density of the mass formed, with the quantity of lime used; also, a difficulty in removing it from the tank. Since then the defendants have abandoned the use of the stirrer, and I presume the saponification could be effected in consequence, with less difficulty; but I could not say that it could be more readily discharged from the tank than in the former operation with the stirrer in use.

X Q. 45. In the first stage of the operation in defendants' processes, when the fat with 7 or 4 per cent. of lime and water is put into the digester and agitated, and gradually heated by the steam up to about, and not over, 212° Fahr., is not this the first chemical result which is obtained—the production of a quantity of neutral lime-soap equivalent to the quantity of lime present?

A. I do not so consider it. Below the temperature of 212° Fahr., and in fact at ordinary temperatures, or, I might say, at the melting point of the fats, the first action of the lime is to form an emulsive compound with the fatty matter and water present. I do not consider this emulsive compound a mere mechanical mixture. A certain amount of chemical decomposition upon the whole mass of fat has commenced; that this is so, I have proven by experiment, and found that by mixing a milk of lime containing 4 per cent. of lime with fats (olive oil being

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the fat used) that an emulsive mass of oil, lime, and water took place. This emulsive mass did not separate into its constituents by the further additon of water, but floated as a mass, upon the excess of water, and by long standing, no separation took place.

I can then only from this experiment say, that this mixture of fat, lime, and water, below the temperature of 212° Fahr. was not a mere mechanical one; and that a certain chemical change must have occurred in the mass.

Upon heating this mass of oil, lime, and water, lime-soap may have been produced, and dissolved in the free fat existing, and being thus dissolved, and with the increase of temperature up to 212° Fahr., and above, with the presence of water, causes a decomposition of the neutral fats beyond the capacity of the lime to decompose the fat, and form merely a neutral lime-soap; although the final result may be, and is, a neutral lime-soap, and free fat acids, when lime in less quantity than will form neutral lime-soap with a quantity of neutral fat is used.

X Q. 46. I read from Watt's Dictionary of Chemistry, London, 1864, vol. 2, page 881 as follows: "When a glyceride (neutral fat) is boiled with excess of alkali, the product is always a neutral soap, and if the quantity of alkali present is less than sufficient to neutralize the whole of the fatty acid present, part of the fat remains undecomposed. 100 parts of hog's lard require for complete saponification 18 parts of hydrate of potassa, the product then consisting of neutral stearate, oleate, etc., of potassa, without excess of either acid or alkali; but, if 100 parts of lard are boiled for 60 hours with 9 parts of hydrate of potassa and a small quantity of water, a homogeneous mass is obtained, consisting of neutral stearate, etc., of potassa, mixed with half the fat in its original state. The mixture thus formed is almost wholly soluble in alcohol, and does not form grease spots, a property on which the power of soap to remove grease spots chiefly depends. The same mixture, boiled with a large quantity of water, is decomposed into soluble soap and unaltered fat.—(Chevreul.")

Please verify the correctness of this extract by comparison with the book now produced, and state whether the experiment and conclusion
756 therein described have been generally received and adopted as correct, by chemists from the date of Chevreul's treatise, 1823, up to the present day.

A. The extract is correct, and the facts as mentioned there are so conceived up to the present day; but this alludes only to a temperature being used equivalent to that of the boiling point of water, 212° Fahr.; beyond this point I conceive, the result to be different.

X Q. 47. I understand you, then, to say, that it is, and has been for 40 years, admitted and received by chemists, that, when fat with 7 or 4 per cent. of lime, is boiled with water at a temperature not over 212° Fahr., neutral lime-soap will be formed, equivalent to the quantity of lime used; and the rest of the fat will be left in its original state of neutral fat; is that so?

(The question objected to by defendants' counsel, inasmuch as it assumes that which has not been testified to in words or in effect, by the witness; the last answer of the witness having reference to a process in which hydrate of potassa was the alkali employed, and no mention being made in said answer of lime.)

A. I cannot say that for forty years this has been an admitted fact with lime, as assumed in the question. I would say, that when 7 or 4 per cent. of lime is boiled at 212° Fahr., with fat and water, as a

final result neutral lime-soap will be formed, and also at the same time a certain amount of free fat acids will also be produced.

X Q. 48. Taking the case where water, fat, and 4 per cent. of lime are boiled at 212° Fahr., is the combination of that lime with the fat, so as to form neutral lime-soap, instantaneous, or is it gradual, requiring some hours?

A. It is not instantaneous, so to speak. In the practical operation of making lime-soap by the old process of candle manufacturing, several hours were employed in making the decomposition.

X Q. 49. At the point of time of the operation, with 4 per cent. of lime, at 212° Fahr., when only one-half of the quantity of lime present had combined with the fat to form neutral soap, and the other half of the lime present is still uncombined and in its free alkaline condition, at that point of time is any free fat acid present?

757 A. I cannot conceive of this divided action of the lime; for, upon mixing the lime, water, and fat together, the lime exerts its chemical influence upon the whole mass of fat present, and I cannot conceive of a partial decomposition as mentioned in the question, as one portion of the lime cannot exert any superior chemical effect over the other. The end of this saponification is abrupt, and a neutral lime-soap would be the result, free fat acids and neutral fat.

X Q. 50. Then, at one instant of time, the whole mass is alkaline, from the presence of a quantity of free lime; and at the next instant of time, it is acid from the presence of free fat acids; is that so?

A. I cannot alter my answer to the previous question, and must say, in reply to the last, that this sudden change occurs the moment the lime-soap is formed, and the acid present, over and above the amount combined with the lime as lime-soap, will show its acidity if separated.

X Q. 51. Up to what proportion of lime to the fat will this production of free fat acid, up to 212° Fahr., continue to take place?

A. I consider it will take place from any proportion up to a full combining equivalent of lime, say 10 per cent.

X Q. 52. I understand you, then, to say that, by boiling at 212° Fahr., water, fat, and a quantity of lime, slightly less than the "full combining equivalent," (say, 9.99 per cent.,) there will, at a certain instant of time, be formed a mixture of neutral lime-soap and free fat acids, without any appreciable neutral fat being present. Is that so?

A. Yes; at the end of the decomposition.

X Q. 53. How soon after the commencement of the boiling, (212° Fahr.,) does this occur?

A. I cannot say.

X Q. 54. Will it occur in about eight hours, the usual time of boiling in the ordinary lime-saponification process, at 212° Fahr.?

A. I conceive that it will occur at or about the end of the operation. Eight hours is the time usually employed in producing this decomposition in the old lime saponification.

Here adjourned until 9 a. m., Wednesday, June 30th, 1869.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

758 Met pursuant to adjournment.

X Q. 55. Does this fact, stated by you, agree with the ordinary experience of manufacturers by the old lime-saponification process?

A. I believe that this sudden transition, or finishing of the decomposition is the experience of manufacturers. In reference to my answer to question No. 52, that the quantity of lime there mentioned, 9.99 per

cent., I understand to be chemically pure lime, not commercial lime; if commercial lime, there would be lime-soap, free fat acids, and neutral fat. There would be, as mentioned previously, more fat acid obtained than that combined with the lime-soap. How much, I cannot say; it can only be determined by analysis.

X Q. 56. Referring to your answer to cross-question No. 47, please state how much free fat acid you have ever found to exist in the product resulting from boiling water, fat, and 7 per cent. of lime, at 212° Fahr., for any given time?

A. I have not made such an analysis. I have treated fats and water in an open tub by passing a current of steam through it, and found, after eight hours of such treatment, fat acids to the extent of 2 per cent. had been produced. This fact, then, coupled with the action of the lime in facilitating the decomposition of fats, as previously mentioned, I can but say that by boiling, say 4 or 7 per cent. of lime with water and fat, a decomposition of the fat into fat acids would be greater than can be attributed to the action of the lime; or that the fat acids would be formed in excess beyond the quantity to produce neutral lime-soaps with the quantity of lime used.

X Q. 57. I understand you, then, to say that you cannot testify from any actual experiment and analysis made by you, that any definite quantity of free fat acid, say even one-half per cent., or one per cent., is produced by boiling at 212° Fahr., water, fat, and 7 per cent. of lime, or water, fat, and 4 per cent. of lime. Is that so?

A. I cannot so testify.

X Q. 58. Do not candle manufacturers use the purest quality of commercial lime obtainable by them for the purpose of their saponification?

A. They do.

X Q. 59. Have you not found by experiment made under an order of court, made in a previous case of Tilghman against
759 Werk, that 11½ pounds of commercial lime, such as used by candle manufacturers in Cincinnati, fully saturated and converted entirely into neutral lime soap 100 pounds of tallow?

A. I have.

X Q. 60. Is it not notorious, from the experience of manufacturers, that 11½ pounds of said commercial lime are not sufficient to convert into neutral lime-soap, 100 pounds of tallow, when boiled therewith with water, in an open tub at 212° Fahr.?

A. It is, at 212° Fahr.

X Q. 61. The experiment referred to in Cross-question No. 59, as made by order of the court, was made in a close vessel at a high temperature and pressure, say about 320° Fahr.; was it not?

A. It was.

X Q. 62. You state in answer to Cross-questions 52, 53, and 54, that by boiling, at 212° Fahr., water, and slightly less than the chemical equivalent of pure lime, a mixture of neutral lime-soap and free fat acid will be found, without any appreciable quantity of neutral fat being left undecomposed. In answer to Cross-questions 59, 60, and 61, you state that although 11½ pounds of commercial lime are sufficient to convert entirely into neutral soap 100 pounds of fat, when boiled therewith in a close vessel at 320° Fahr., yet, that it is notorious that 11½ pounds of said commercial lime are not sufficient to convert 100 pounds of fat into neutral soap when boiled therewith, and with water, at 212° Fahr. Please explain the contradiction between the results obtained in practice, on the large scale, and those referred to by you in Cross-questions 52, 53, and 54.

A. In reply to the question, I will say that manufacturers of fat acids have worked by rule; as a general thing are not chemists, and have used 14 pounds of commercial lime, because they found others using it in the same manufacture before them, and not as a result of any experiment of their own. I know that some manufacturers other than defendants were aware that less lime would produce the result, and have used less lime than 14 pounds, and accomplished the decomposition of the fats into fat acids and glycerine by a less quantity than 14 pounds
760 of lime. In carrying out this process they used deeper tubs in the decomposition, and carefully covered the same, to retain as much as possible of the heat from the steam used in the decomposition. It is notorious, then, from the facts mentioned above, that 14 pounds of lime were used, but it was not universal. In reply to Question 52, it is a hypothetical question, and I so answered it in a chemical light.

X Q. 63. I understand, then, that your statement in the answers to Cross-questions 52, 53, and 54, is not founded upon any actual experiments and analyses made by you, but that it is the result of your hypothetical reasoning, merely; is that so?

A. Yes.

X Q. 64. Which is the more active and efficient chemical agent in saponifying fats, potassa or lime?

A. I would say the potassa was.

X Q. 65. Referring to the experiment of Chevreul, quoted in Cross-question 46, can you, as a chemist, state, that if lime had been substituted for potassa in said experiment the chemical action of the lime would have been greater than that of potassa?

A. In the experiment of Chevreul, where less potassa than would form neutral soap with the fat was used, I understand that the result was a soapy mass, which dissolved almost completely in alcohol; and that water from the soapy mass separated the fat in excess. We have no mention of any analysis of this fat that was separated from this soapy matter by water, whether it was entirely neutral fat, or contained any free fat acids. I am of the opinion that if an analysis had been made of it, some free fat acid would have been found. So with lime; less than an equivalent, a certain amount of fat acids would be produced. I say this from general knowledge of the chemical reactions of alkalies on fat, partly derived from experiment. I would say that potassa would probably cause the decomposition of the fat in a shorter time than lime.

X Q. 66. If the alcoholic solution of the soapy mass in Chevreul's experiment had been tested, and found to give no acid reaction to test paper, would that be a sufficient proof to you, as a chemist, that it did not contain any appreciable quantity of free fat acid or acid soap?

761 A. I might say yes. The quantity might have been small, though, and would have made it probably a difficult point to determine simply by the use of the test paper.

X Q. 67. Can you name any mode, known to chemists, of proving the existence of free fat acids in an alcoholic solution, when in quantity less than will change the color of test paper?

A. Litmus paper is the usual means of testing the presence of acidity; but the fat acids do not give as sharp reactions as many others. And being mixed as in the experiment above mentioned as Chevreul's, with the soap and the fat all dissolved together in the alcohol, the reaction, I can conceive, with a small percentage of fat acid present, not to be definitely proven to exist simply by the means of litmus paper. I should

prefer to determine this point by testing the solubility of the original fat and the fat separated, and would give as the amount of fat acids the difference of their solubility in alcohol.

X Q. 68. Suppose you have a small quantity of fatty matter dissolved in alcohol, how can you tell whether that fatty matter is fatty acid or neutral fat?

A. I should then test it by litmus paper.

X Q. 69. And in so doing you would have the sanction of chemical authorities, so far as you know?

A. I would.

X Q. 70. If, then, Chevreul, in his above experiment, found that the alcoholic solution of the soapy mass produced gave no acid reaction to the test paper, he thereby ascertained the absence of fatty acids in the best manner known to chemists then or now, did he not?

A. I have said that the solution of soap, fat, and water might contain a small percentage of fat acids, and yet give no reaction to litmus paper. I so think, and, in answering the question above, referred to it. I would also say that Chevreul did attempt to prove the absence or presence of acids by the best method then or now known for detecting the same.

X Q. 71. When did you first make the experiment described by you in answer to Cross-question 56, wherein you obtained free fat acids by boiling water and fat in an open tub? Describe said experiment particularly, and your mode of analysis of the product.

A. The experiment referred to was made about four weeks ago;
762 the fat was placed in an open tub about four feet in height, about half filled with equal quantities of tallow and water; it was boiled by a current of steam being thrown into it, by means of a pipe, and fresh water added from time to time to keep up the original bulk of water lost by evaporation. This process was carried on for 8 hours. At the end of the operation a specimen of the same was taken from the tank and analyzed by me in the following manner: by treating it with boiling alcohol of 94 per cent. strength, and ascertaining the amount dissolved by it. The original tallow was treated in like manner, and the difference between the two solubilities taken as the measure of decomposition.

X Q. 72. Does the foregoing describe the whole of your process of analysis?

A. It does.

X Q. 73. As generally received by chemists, do fat acids and lime combine together chemically in all proportions, or only in certain definite proportions? If the latter, state in what definite proportions, taking stearic acid as a type.

A. They combine in definite chemical proportions. A neutral lime-soap only is known to chemists and mentioned in chemical works. 28 pounds of lime combine with 275 pounds anhydrous stearic acid in lime-soap and form neutral lime-soap.

X Q. 74. When 4 pounds of lime are boiled with water and 100 pounds of fat, at 212° Fahr., what definite chemical compound is formed, according to the ideas generally received and acknowledged by chemists?

A. Neutral lime-soap.

X Q. 75. If neutral lime-soap and water are heated together in a close vessel to a temperature of from 320° to 350° Fahr., what will be the result?

A. I have not performed the experiment, but would say that no decomposition of the lime-soap would occur.

X Q. 76. In the experiment made by you under order of the court, referred to in Cross-question 59, was there not present neutral lime-soap and water, heated to a temperature of about 320° Fahr. in a close vessel?

A. Yes.

X Q. 77. Was there any decomposition of the neutral lime-soap in that experiment?

763 A. In the lime-soap analyzed by me there was no decomposition.

X Q. 78. From your own experiments is it true or not that fat, heated with water to a temperature of about 320° Fahr., in a close vessel, is, to some extent, converted into free fat acids and glycerine?

A. Yes; it is true.

X Q. 79. In the paper of Pelouze, heretofore referred to by you, he states, "I have besides assured myself that at a temperature of 165° C., (329° Fahr.,) water does not act upon the oils; to 'undouble' them it is necessary that the mixture of fatty matter and of water should attain, and preserve during a very long time, the temperature of 220° C., (428° Fahr.,) assigned by M. Berthelot, to this latter saponification." State whether you have not ascertained from your own experiments that this assertion of M. Pelouze is absolutely incorrect.

A. I would state that it is not absolutely true. Decomposition with water will take place at that temperature, 320° Fahr.; also at lower temperatures; but the higher the temperature the more rapid the decomposition.

X Q. 80. In the same paper M. Pelouze says: "In the reactions of which we have just spoken, it is understood that water, at a temperature of 150° to 160° C., (302° to 320° Fahr.,) can decompose a neutral soap into an acid soap, and a very basic soap." Is not this hypothesis of M. Pelouze disproved by your own experiment, made upon a large scale, described in answer to Cross-question No. 59?

A. As a final result of the action of lime upon fat, neutral lime-soap is unquestionably the result; but I can by no means say that such is the condition of the lime and fat from the beginning to the ending of the process. Pelouze merely attempts, in the passage quoted, a hypothetical explanation; that is all. I believe he is correct in it. That there is a chemical reaction occurring in the tank other than we are acquainted with is evident, and the results of experiments so prove it, let the final result be what it may.

X Q. 81. Does not the hypothesis of Pelouze assume the existence of two new lime-soaps, namely, acid lime-soap and basic lime-soap, neither of which has been seen, recognized, or described by chemists?

764 A. I have said he merely uses the terms in the effort to explain the decomposition. It is true that the same are not known or mentioned in chemical works; but they may exist and be found under such conditions and circumstances that we may never know of them only through theory.

X Q. 82. In DeMilly's process of decomposing fats by a small quantity of lime with water at a high temperature and pressure, what, in your opinion, is the upper limit of high temperature and pressure that can be used without changing it into another chemical process?

(Question objected to by counsel for defendants for vagueness, inasmuch as the meaning of the words "chemical process" is not defined; in other words, the counsel for complainant should make known whether or not he uses said expression as being synonomous with patentable process; since two processes may produce the same chemical results, and

yet, operating under different conditions as to time, temperature, etc., each be the subject-matter of valid letters-patent.

Counsel for complainant replies that the witness has already stated, in his answers to Cross-questions 30, 31, 32, 33, and 34, that he considers the process used by M. Ropes, that used by DeMilly, the two processes described by defendants in their two answers herein, and the process used by M. Werk in 1860, to be all substantially the same "chemical processes." In Cross-question 82 complainant's counsel uses the phrase "chemical process" in the same sense as it is used by the witness in his said answers, and has no reference to patentability.)

A. In the process of DeMilly, with two per cent. of lime a pressure of eight atmospheres is named; the temperature due to this pressure is that at which practical decomposition of fat acids, lime-soap, and glycerine may be carried out. I cannot, therefore, conceive of the necessity of the cost and risk of using a higher pressure and corresponding temperature than that named. I also would say that I cannot see how a higher temperature would alter its chemical character; it would be, even at a higher temperature and pressure, and with less lime, a different process from that with water alone. At the temperature named, and even higher, the result would be the same, namely, lime-soap, fat acids, and glycerine; with water and fat at high temperatures
765 the result would be free fat acids and glycerine. The two, therefore, are distinct and different chemical processes, at whatever temperatures they may be carried on.

X Q. 83. In defendants' processes, with either 7 or 4 per cent. of lime, is any of the fat acid distilled?

A. There is none.

X Q. 84. In the process of Scharling (Defendants' Exhibit 12) is all the fat acid mentioned as having been produced by him described as having been distilled and found in the condenser?

A. It is.

X Q. 85. In said experiment of Scharling, is any liquid water described as having been mixed with the fat while fat was at the temperature of 160° C., (320° Fahr.?)

A. There is not.

X Q. 86. In said experiment was any pressure above that of the atmosphere applied to the still?

A. No.

X Q. 87. In said experiment was the fatty acid converted into vapor in the still, and carried over in the state of vapor from the still into the condenser, and there cooled into a liquid or solid product?

A. Scharling does not state in this experiment how much fat was left in the still; he says from the distillate he obtained one pound of fat acid. Fat acids will not distill at this temperature; consequently I must say that fatty acids produced must have been carried over mechanically, together with the glycerine produced, and more or less of free fat, and from this mixture of fat acids and neutral fat and glycerine he obtained his pound of fat acids named.

X Q. 88. Then you understand from Exhibit 12 that the fat acids produced did not pass in a state of vapor from the still into the condenser; is that so?

A. I so understand it.

X Q. 89. You understand, then, from Exhibit 12, that the fat acid produced passed in the state of liquid from the still into the condenser; is that so?

A. I will say not absolutely in a liquid form, but in a finely divided state, with a current of steam; it was not a vapor.

X Q. 90. Was it a liquid?

A. It was not a liquid mass; the atoms by coalescing would unite and form a liquid.

766 X Q. 91. Were the individual "atoms" liquid?

A. If the watery particles composing a mist can be called a liquid, they were.

X Q. 92. How did this mist of liquid fat first separate from the mass of melted fat in the still?

A. I will say that this was a mechanical distillation; that the particles of oil were carried over by the steam rushing through it. How this was done by it, I presume, is, that the ebullition split up the oil into small particles, which are carried over by the elastic force of the vapor, as dust will be floated and carried by the air. I have distilled hundreds of gallons of oil by this process of mechanical distillation.

Here adjourned until 9 a. m., Thursday, July 1st, 1869.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

Met pursuant to adjournment.

X Q. 93. What kind of oils have you thus distilled?

A. They were coal and petroleum oils.

X Q. 94. Do you consider the common process of distilling oil of turpentine from crude turpentine by the aid of water or steam to be same kind of mechanical distillation you have mentioned?

A. I believe that it is; so also other essential oils.

X Q. 95. Is this kind of mechanical distillation well known to chemists and often used in the chemical arts?

A. It is.

X Q. 96. The mist, or very fine drops of the oil, which are mechanically split up and carried over by the steam, like dust by the air, must be of the same nature as the oil remaining in the still from which they have been thus mechanically split or separated, must it not?

A. They are of the same nature, provided the steam had not the power of decomposing the oil into other products; in such a case the products of decomposition, as well as the original oil not decomposed, would be then carried over.

X Q. 97. Can you produce any chemical or technical work in which this process of "mechanical distillation" is described or recognized to exist?

767 (Objected to by counsel for defendants as irrelevant, the witness having been interrogated in reference to Scharling's process, which he, the witness, has denominated a mechanical distillation.)

A. It is mentioned in most works in pharmaceutical chemistry. In Parish's Pharmacy, Philadelphia, 1866, p. 300, this passage occurs: "The oil, though its boiling-point is always much above that of water, is readily diffused in the steam, and when this is condensed in the refrigerated part of the apparatus, the oil, if in excess, separates."

In Fownes' Chemistry, mechanical distillation is also mentioned, p. 426: "In this reaction both the fatty acid and the glycerine assimilate. The elements of water and the excess of steam carries over a mechanical mixture of glycerine and the fatty acids."

X Q. 98. And you understand and assert that in the two cases just cited the oil which was distilled did not separate from the substance in the still in the state of vapor, but in the state of mist or fine drops,

mechanically split up and carried over by the steam, like dust carried by the air; is that so?

A. I am satisfied that in the distillation of essential oils that the oil, to a great extent, is dissolved in the water present, and that by ebullition the oil thus dissolved is carried over by the steam of water, and, as this cools, the solubility of the oil being less in the condensed water from the steam, that such excess will float upon the surface of the water, the condensed water still containing sufficient of oil, mechanically mixed with water, to give it a milky appearance. I do not consider that the oil that has been distilled has ever been in the form of vapor; this refers to the essential oils.

In regard to the case in Fownes' Chemistry, the oil distilled may or may not have been in the form of vapor. I know by practical experience in distilling coal-oil that some vapors have but slight expansibility, and unless they are driven from the still through the mechanical agency of a current of steam, the oil in a vapor, from being submitted to a further action of heat, will suffer a decomposition to a certain extent; steam, then, in this case, mechanically assists in the distillation.

X Q. 99. And in the case of Scharling's experiment you still as-
768 sert that the substance distilled over was not separated from the substance in the still in the state of vapor, but that it was mechanically separated, as mist or fine drops by the steam, like dust by the air; is that so?

A. That is my impression.

X Q. 100. Then a substance may be distilled without being converted into vapor; is that so?

A. From practical experience I say so; but at the same time would say that by the term "distillation," as generally used, vaporization of the substance distilled is understood; mechanical distillation is a process well known to pharmaceutical and manufacturing chemists.

X Q. 101. I read from Watt's Dictionary of Chemistry, London, 1864, page 337: "Distillation is the conversion of a substance into vapor, and the condensation of the vapor in another part of the apparatus by cooling." I read from Parish's Pharmacy, cited by you above, page 295: "To distill a solution, it is first converted into vapor by the application of heat, and the vapor is then condensed in a separate part of the apparatus." I read from Fownes' Chemistry, cited by you above, page 70: "The process of distillation is very simple; its object is either to separate substances which rise in vapor at different temperatures, or to part a volatile liquid from a substance incapable of volatilization. * * * Every distillatory apparatus consists essentially of a boiler, in which the vapor is raised, and of a condenser, in which it returns to the liquid or solid condition." I now ask you, as a chemical expert, whether the term distillation, as generally understood and received by chemists, does not imply as its radical and essential idea the conversion of the substance distilled into the state of vapor in the still, and the subsequent condensation of this vapor into a liquid or solid form?

A. I replied to this question, in Answer 100, that such is the use of the term distillation, but insist that mechanical distillation is also proper. It is a compound operation, distillation and separation, and the substance separated passes over mechanically with a distillate, whether it be in a vapor or otherwise.

X Q. 102. Can you produce any chemical, pharmaceutical, or technical work, in which it is plainly and intelligibly stated that a substance can be distilled without being converted into vapor?

769 A. I would say that the passage quoted from Parish's Pharmacy proves the point.

X Q. 103. In that work is any distinction made between the two kinds of distillation you speak of, to wit: (A) distillation in which the substance distilled is converted into vapor; and (B) distillation in which the substance distilled is not converted into vapor?

A. Yes, there is; on page 299 distilled water—vaporization—is indicated; page 300, "oleo destillata;" the oil may or may not be in vapor form.

X Q. 104. In Scharling's experiment is it anywhere stated that the distillation spoken of was a different kind of distillation from that generally understood by chemists, in which the substance distilled is converted into vapor? If so, please quote the words.

A. It is not, in so many words, but with my knowledge and experience in distillation, my opinion is that it must have been a mechanical distillation. I would say that at the temperature at which this operation was performed, I do not think that the distillate or distilled oils and fat acids were in a vapor form.

X Q. 105. Did you ever repeat Scharling's experiment?

A. I have not.

X Q. 106. Do you know, by experiment, whether or not fat acids of palm-oil will be converted into vapor, and distill over as vapor, in a current of steam at the temperature named by Scharling, 160° C., (320° Fahr.?)

A. By experiment I do not know.

X Q. 107. Was the process of Scharling practically employed for manufacturing fat acid, prior to 1854, as far as you know?

A. The use of superheated steam in decomposing fats into fat acids, I believe was used before this experiment of Scharling; it was used in England, I believe, and patented by Dubrunfaut, of Paris, on the 28th of August, 1841. The process of Dubrunfaut I consider nearly the same as that of Scharling; the patent of Dubrunfaut was issued 28th of August, 1841; whether it was practically used or not I cannot say.

X Q. 108. Was the process of Scharling, at the heat mentioned by him (320° Fahr.) practically employed for manufacturing fat acids, prior to 1854, as far as you know?

A. I cannot say that it was.

770 X Q. 109. Does the paper of Scharling (Exhibit 12) make the announcement of any discovery? If so, what?

A. I think it does; that decomposition of the fats into fat acids, without decomposition of the glycerine produced.

X Q. 110. The production of glycerine in Scharling's experiment is not mentioned by Scharling himself, in Exhibit 12, but is an inference or deduction of your own from other facts stated in Exhibit 12; is that so?

A. It is so.

X Q. 111. In the chemical and technical works you have consulted, is Scharling mentioned as the author of the discovery that glycerine, as well as fat acids, could be obtained by distilling fats with superheated steam? If not Scharling, state who is credited with that discovery, and what date is given for it.

A. In technical and chemical works, to Mr. Wilson, of Price & Co.'s works, London, the credit is given of this, and a patent taken for it both in this country and Europe—in Europe on the 24th of July, 1854.

X Q. 112. Does not Mr. Wilson, in a lecture before the Society of Arts, (London, January 25th, 1856, page 127 complainant's record, Tilghman against Mitchell, agreed copy,) state that the idea of obtaining glycerine, as well as fat acids, by distilling fat with superheated

steam, was suggested to him by his witnessing the operation of complainant's process in the tube or coil apparatus?

(Objected to by counsel for defendants, inasmuch as the lecture referred to of Mr. Wilson has been offered in evidence by the complainant, and speaks for itself as to such assumed fact; and the witness is requested, if his attention is called to said lecture, to refer to the entire paper as printed.)

A. I would say, not in so many words: it is merely suggested to him to try over again some experiments that he had performed before.

X Q. 113. From Mr. Wilson's lecture is it not evident to you that up to the time of his witnessing the operation of complainant's process in the coil apparatus, he, as a practical chemist and manufacturer, was not acquainted with the fact that glycerine, as well as fat acids, could be obtained by distilling fats in a current of superheated steam?

771 (Objected to for the reason that it makes no sort of difference whether Mr. Wilson knew or did not know of this fact, if it be true, as testified to by the witness, that Scharling, in 1850, produced free fat acids and glycerine by the action of superheated steam in the process described in Defendants' Exhibit No. 12.)

A. There is much stress in my examination placed upon the production of glycerine; I would say that only of late years has this become an article of production and commerce, and formerly was merely a chemical curiosity; it had no commercial value, and was applied to no known useful purposes in the arts, pharmacy, or medicine. In the decomposition of the fatty matters, until about the date of the time of the complainant's patent there was but little use made of glycerine, if any; and in the decomposition of fats this substance was not taken into consideration at all, and was thrown aside as a worthless product; such being the fact, in the decomposition of fats, the object sought to be obtained was the production of fat acids, and whether the glycerine was decomposed or not, in this decomposition, there being no value attached to it, no mention was made whether it was decomposed or not. I have no doubt that free fat acids and glycerine were made prior to the patent of complainant, also prior to that of Wilson, and that Scharling, in his experiment, did produce fat acids and glycerine. I do not think, from Mr. Wilson's lecture, that he was ignorant of the fact that glycerine, as well as fat acids, would be produced by the action of steam upon the fats.

X Q. 114. You think, then, that Wilson patented this process as his own original invention, and swore to it as such, knowing at the time that it was old: is that so?

(Objected to by counsel for defendant, inasmuch as Mr. Wilson may have known of the discovery prior to the date of his patent, and yet be entitled to valid letters-patent for his process (or mode of operation) of conducting it; and inasmuch, further, as Mr. Wilson, under the laws of England, was not required to make oath to the said supposed discovery.)

A. The question is a broad one: the general facts in relation to this decomposition he may have known, and may have and did discover the best practical method and limit of temperature at which the decomposition could be successfully performed, together with the

772 volume of steam to be used, peculiar combination of apparatus, and thus be virtually the discoverer of his mode of carrying out the decomposition.

X Q. 115. In his claim, does he limit his patented invention to any form of apparatus or precise range of temperatures; or does he claim

broadly the distilling of fats in an atmosphere of steam, so as to produce glycerine, together with the fat acids?

(Objected to for the reason: First, that the letters-patent of Mr. Wilson is not produced, and the copy thereof is not a full copy of the specifications; and again, for the reason that the interpretation and construction of said patent is a question of law, to be passed upon by the court, and not by the witness.

In answer to the said first objection, the complainant's counsel refers to the agreement filed in this case, whereby "the printed copies and documents, as contained in the original suit of R. A. Tilghman vs. M. Werk, the same against R. G. Mitchell, are true and correct transcripts of the originals of which they purport to be copies.") * * * *

A. It is a claim for the production of fat acids and glycerine, by means of superheated steam, and by using a lower temperature than had been practically used before in the decomposition of fats, and fixes this temperature to be between 550 and 600° Fahr.

X Q. 116. From the technical works you have consulted, and from the patents of Gwynne and Wilson, patent 1843, No. 9944 and No. 10000, and 10191, does it not appear that Mr. Wilson had been practically engaged in distilling fats, in various ways, with superheated steam, from the year 1843; and that he was, in 1855, the manager of the largest manufactory in the world for the production of fat acids by distillation by superheated steam?

(Objected to, as it is a matter of the utmost indifference as to what Mr. Wilson was engaged at during those years.)

A. He was so engaged; I have no doubt has performed hundreds of experiments upon the decomposition of fats by steam into fat acids and glycerine, of which no note has been taken or mentioned in any technical work; and in 1855 was the manager of the most extensive candle works, by distillation, in the world.

X Q. 117. Where is palm-oil procured from?

773 A. Commercially, largely from the west coast of Africa.

X Q. 118. As it is found in commerce, does it not generally contain a quantity of free fat acids? In this relation please examine Berzelius, Paris, 1860, vol. 6, page 500, and the patents of Gwynne and Wilson, and Wilson and Payne, above referred to.

A. Palm-oil, as found commercially, like most vegetable fats, contains more or less of free fat acids. Fats of vegetable origin pass into this condition more rapidly than those of animal origin.

X Q. 119. Did you ever examine a sample of commercial palm-oil which did not contain free fat acids?

A. I have not.

X Q. 120. Suppose that the palm-oil used by Scharling had contained free fat acid, like commercial palm-oil, would not this free fat acid have distilled over with the steam, without the production of glycerine?

A. Of course it would; the glycerine had already formed by the decomposition of the original mass.

X Q. 121. Is not one part the patent of Gwynne and Wilson, 1844, No. 10191, Compl'ts Ex. No. 10191, Tilghman vs. Mitchell, specially directed to the distillation with superheated steam of "palm-oil in its crude state as imported?"

A. Yes sir; it is.

X Q. 122. To what extent can said crude palm-oil be properly distilled down, according to the directions and description of that part of said patent?

A. The question alludes to part of the process, and cannot be answered without a reference to the whole.

X Q. 123. Do not the patentees there state that they find it preferable to "distill over only about half of the palm-oil under process, in the first distillation?"

A. They do, and give no reason why they prefer so to do. Their preferring to do so may be only from an imaginary advantage, and of no real value in the process.

X Q. 124. Do they not state that they convert the residuum of said distillation into fatty acids by a suitable means, and afterwards distill the fatty acids so obtained?

A. They do say that they convert the residuum into fatty acids.

774 Now, what do they mean by residuum? I presume they mean the dark pitchy substance left in the still; and separate from this the fatty acids by another distillation, as is practiced generally with the residuum left in the still in the manufacture and distillation of stearic acid by superheated steam. I by no means consider that they meant anything else by the term residuum but this mass described, and known in commerce as candle-pitch.

X Q. 125. They state that the "residuum may be converted into soap by methods similar to that employed in making soap from ordinary palm-oil." Do you understand from this that the residuum thus spoken of is candle-pitch? Did you ever hear of making soap of candle-pitch?

A. He speaks of soap in this patent twice: first, from the distilled product; second, from the residuum; says they may be converted into soap by methods similar to that of palm-oil. From the nature of the process the residuum must be as I mentioned before. The distillation may not have been carried so far as to leave this residuum merely a pitchy mass of fat acids and altered fat acids. More or less of the oil and fat acid may have been left in, and the product, in consequence, suitable to form a low grade of soap. It is not customary in this country to use candle-pitch for soap making, though they may do so in England.

X Q. 126. The patentees state that they "distill over about half of the palm-oil under process;" the residuum of said distillation would be the other half of the palm-oil, would it not?

A. They distill over about half of the palm-oil under process; it would be.

X Q. 127. They further state "another method of dealing with the residuums is to convert them into fatty acids, by means similar to those used in the manufacture of stearic acid, or by other suitable means, and to distill the fatty acid so obtained," etc. If the residuum was to be converted into fatty acids, does it not show that said residuum was not already fatty acids, but was left practically in the state of neutral fat?

A. How much neutral fat and fat acid there might have been in this residuum I cannot say. I presume from the statement in the patent that there was neutral fat there, which was converted into fat acids by the usual means.

X Q. 128. In the patent of the same parties, December 28th

775 1843, No. 10000, they state, "we have particularly observed that fats and oils in their natural state are not well adapted for distillation, owing, as it appears, to the presence of the ingredient called 'glycerine,' and that although fats and oils can be distilled in their natural state, and the distillation itself destroys or decomposes the 'glycerine' it is a perferable mode of operation to abstract, destroy, or decompose the 'glycerine' in the first instance, and afterwards to submit the fatty or oily matters to distillation in the acidified or modified state produced by such action."

Does not this explain why the patentees in their subsequent patent direct the distillation of crude palm-oil should be carried to the extent of one-half only, the pre-existent free fat acid having at that point been all distilled over; and also why they direct that the residuum of natural fat should be converted into fatty acids, or have its "glycerine abstracted, destroyed, or decomposed," in order to render it suitable for distillation?

A. No.

Here adjourned until 9 a. m. Friday, July 2nd, 1869.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

Met persuant to adjournment.

The witness desires to state that his answers to cross-questions 124 and 125 were based upon certain interpretations of Wilson and Gwynne's patent of 1844. My answers were based upon the understanding of the patent, to wit, that there was a redistillation of the product first distilled, together with the residuum of that first distillation, which I find upon further examination of the patent not to be the case.

X Q. 129. Did Gwynne and Wilson obtain glycerine as well as fat acids in the processes of distillation of fats by superheated steam, described in their patents No. 9944, 10000, and 10191, above referred to, or in any of said processes?

A. In No. 9944 and No. 10000, also 10191, glycerine is not mentioned as a product; but I would say that in 10191 and 9944, that glycerine was produced; this I say from the well-known fact stated in a
776 later patent of Wilson & Payne, 1854, No. 1624, that by the action of superheated steam upon neutral fats, it produced fat acids and glycerine.

X Q. 130. Did Gwynne & Wilson know that glycerine was produced in their processes described in their patents No. 9944 and No. 10191?

(Objected to as immaterial and as calling upon the witness to prove that which it is impossible for him to know.)

A. I should say from their knowledge of the nature of fatty matters, of saponification, and so forth, that they did; I have no other means of arriving at this conclusion.

X Q. 131. Did said patents No. 9944 and 10191 make known to the public the fact that glycerine as well as fat acids could be obtained by distilling fats in superheated steam?

(Objected to, inasmuch as it does not appear that the patents themselves were known to the public, except by that constructive knowledge which the grant of letters-patent implies.)

A. Those patents did not. Neither the public nor the patentees were interested in this fact. That glycerine was produced must be patent to those who had any knowledge of the nature of the decomposition. The object of the decomposition was simply for the production of fat acids, not fat acids and glycerine, as glycerine then was not an article of commerce, or only to a limited extent.

X Q. 132. You say, in answer to cross question 129, that in said patents, Nos. 9944 and 10191, glycerine is not mentioned as a product; and you say, in answer to cross-question 131, that those patents did not make known to the public the fact that glycerine could be produced by the processes therein described; by what means do you obtain the knowledge that glycerine was obtained as a product in the processes described in said patent?

A. It is a well-known fact now that fats heated with steam will be decomposed into fat acids and glycerine; this I learn from Scharling's

experiment; and in Wilson and Payne's patent of 1854 it is used as an industrial process; in patent 9944, steam is named; also, carbonic acid. The carbonic acid, even if not used in connection with steam, contains water mechanically mixed with it, which upon being heated in the process was converted into steam; steam then was present, even
777 with the carbonic acid used. In patent 10191, steam alone is used to distill over one-half of the fat: fat acids and glycerine must, then, have been produced.

X Q. 133. Can you swear that you have ever seen any publication of date earlier than Wilson and Payne's patent, July 24th, 1854, in which glycerine is explicitly mentioned to be a product of the distillation of fats by superheated steam? Please answer directly, yes or no.

A. I have not seen any such publication; but would say that by its not being published by no means proves the fact that it was not known and observed prior to the date named.

X Q. 134. Can you swear that you have seen any publication of date earlier than January 9th, 1854, in which it is explicitly mentioned that fats can be decomposed into free fat acids and glycerine, or into acid soaps and glycerine, by the use of a quantity of alkali less than the chemical equivalent, in connection with water at a high temperature and pressure? Please answer directly, yes or no.

A. I cannot.

X Q. 135. Can you swear that you have ever seen any publication of date earlier than January 9th, 1854, in which it is explicitly mentioned that fats can be decomposed into free fat acids and glycerine, by the action of water at a high temperature and pressure? Please answer directly, yes or no.

A. I have not seen such publication.

X Q. 136. In defendants' processes, is water heated to a steam-pressure of 75 to 80 pounds, and a corresponding temperature always present during the operation in the digester?

A. Not from the beginning to the end of the process, but from the time that the fat and water in the tank is brought to that temperature by the steam issuing into it, and from that time to the end of the operation.

X Q. 137. Is it essential to the success of the process practiced by them?

A. It is so considered.

X Q. 138. You have testified in your examination-in-chief that, in an experiment made by you in defendants' digester, and that of G. Shillito, where fat and water alone were used at the same temperature and pressure, and for the same time as are used by defendants' in their processes, you found that a certain quantity (7 to 11 per cent.) of
778 the fat was converted into free fat acids and glycerine; please state whether anything, and, if so, what prevents or hinders the same action taking place between the water and the fat in defendants' processes, where 7 or 4 per cent. of lime are used?

A. I cannot conceive of the water and fat in one case, water, fat, and lime in another, being in the same relative condition. There is no question that water is the agent in the decomposition in both, and that the lime facilitates the change of the fat into fat acids and glycerine. The same action of water, no doubt, takes place in both, but in one instance is influenced and assisted in decomposing the fat by alkali. With the lime, 60 per cent.; without the lime, only from 7 to 11 per cent. under the same conditions of time, pressure, and temperature. This,

then, is, at all events, a different and more rapid chemical result, be the action of the water in either case the same.

X Q. 139. What limits of temperature, if any, are fixed in complainant's patent for the chemical action of heated water upon fat to produce fat acids and glycerine?

A. The patent mentions that the mixture of fat and water *are* to be placed in any convenient vessel, and heated to the melting-point of lead, until the operation is complete. Again, "the melting-point of lead has been mentioned as a proper heat to be used in this operation, because it has been found to give good results." I take this to be, then, the temperature at which the operations are to be conducted. There is, however, mentioned that palm-oil, the decomposing of the same can be effected at the melting-point of bismuth. I take these two temperatures, then, to be those used in carrying out the process of complainant. The melting-point of lead to be about the temperature used for the decomposition of fats of animal origin; and the lower temperature that at which vegetable fats, such as palm-oil, may be decomposed. The limits, then, are between the melting-point of lead and bismuth. As a chemist and manufacturer, I should so construe the patent.

X Q. 140. Do you understand from said patent, that at 510° Fahr. the decomposing power of the water on the fat would be less powerful than at 612° Fahr.?

A. I so understand it.

X Q. 141. Do you understand therefrom that in proportion
779 as the temperature of the operation is lowered, the length of time required becomes greater?

A. I understand no such thing from the patent; I see no mention where any such information may be derived, that a manufacturer or chemist, at the date of this patent, could infer.

X Q. 142. If, at a given heat, (612° Fahr.,) a certain time (10 minutes) is directed, and if the decomposing action of the water becomes more powerful as the heat is increased, would it not be reasonable to infer that as the heat is increased less time would be required?

A. I cannot say so; for there must be a limit to the degree of heat used; the increase of heat, beyond a certain point, would decompose the fat acids, and produce acroleine, and thus defeat the end in view. I would say that I understand the temperatures named in the patent to be the highest temperatures at which the decomposition could be safely performed; and the statement that increase of heat decomposes the fats more rapidly means that from the lowest temperature named to the highest, and not to an indefinite point beyond.

X Q. 143. Do you understand from the patent that at 440° Fahr., the lowest temperature specifically named therein, a longer time is required than at 660° Fahr., the highest temperature specifically named therein?

A. There is no mention as to time further than that mentioned with the coil-apparatus, and, as I presume all the experiments were made in such apparatus, that the lower temperature named at which the decomposition of palm-oil did occur, the same length of time, as mentioned as occupied in this decomposition; consequently palm-oil, at this temperature, was decomposed in the same time that other fatty matters were.

X Q. 144. Taking the case of a fat, for which ten minutes' time was directed at 612° Fahr.; and suppose that you wish to operate on that same fat at 510° Fahr., would you understand from the patent that the time then required would be more than ten minutes, or less than ten minutes, or exactly ten minutes?

A. I might try the experiment; if there was any difference in the time required, note it; but from the general wording of the patent, I have nothing to lead me to believe that such fat will be decomposed at 510° Fahr. in ten minutes, or ten hours.

780 X Q. 145. Do you understand from the patent that a fat for which ten minutes is directed, at 612° Fahr., could be decomposed at 600° Fahr. in any time greater than ten minutes?

A. The melting-point of lead is not named as a specified heat at which this decomposition may take place; consequently, I should expect, with this latitude of the language, to decompose the same fat in the same time at 600° Fahr.

X Q. 146. What would you expect at 550° Fahr.?

A. I should not expect to produce the decomposition so rapidly, if at all.

X Q. 147. Would you understand from the patent that whenever the decomposition took place at all, it would take place more rapidly as the heat was increased, and more slowly as the heat was diminished?

A. From a certain temperature up, I do; below which I understand that decomposition would not take place at all; I infer that about the melting-point of bismuth such oil as palm-oil may be decomposed; and that a higher temperature, about the melting-point of lead, is the point at which fatty oils of animal origin may be decomposed. I can infer nothing from the patent that would lead me to believe that any decomposition would take place at a temperature sensibly less than that of the lowest point named, the melting-point of bismuth; the rapidity of the decomposition, also, as named, leaves but a small margin for any decrease of time in the operation, by an increase of temperature too small to be observed.

X Q. 148. The facts that the expression in the patent is "at or below the melting-point of bismuth," and that the temperature of 440° Fahr. is specifically mentioned in the patent, makes no difference in your foregoing opinion; does it?

A. It does not; I regard the melting-point of nitrate of potash and the melting-point of tin precisely in the same light of that of a thermometer; they were merely used in this case to determine the temperatures; and have, in my mind, little or no bearing upon the temperatures at which the process is to be carried on.

X Q. 149. Then, as far as you learn from the patent, the decomposition of the fats by water commences suddenly for animal fats at about 600° Fahr., and ceases suddenly at about 612° Fahr., taking place always in ten minutes; is that so?

781 A. I so understand, that in the coil-apparatus animal fats at about the melting-point of lead are rapidly—I might say violently—decomposed; and that this decomposition may also take place at a higher point above, and also at a temperature somewhat lower, and the operation would require about ten minutes.

X Q. 150. Quote the words of the patent stating that animal fats require a heat of about the melting-point of lead.

A. Animal fats, as such, are not mentioned; but the mentioning "of the change of fatty matters into fat acids and glycerine takes place with some materials (such as palm-oil) at or below the melting-point of bismuth." The only inference I can make from this is that the higher temperature named had reference to animal fats.

X Q. 151. Is the chemical action of the water on the fat substantially the same, or different, "at or below the melting-point of bismuth," and at or "above the melting-point of lead?"

A. They are chemically the same, but at a higher temperature than the melting-point of lead the products of decomposition might be destroyed.

X Q. 152. Down to what limit of temperature "below the melting-point of bismuth" would the chemical action continue to be the same?

(Counsel for defendants inquires of complainant's counsel whether the question is intended to call for the witness' opinion as deduced from the complainant's patent, or as derived by the witness from experiments and processes performed and witnessed by him since the date of said patent.

Complainant's counsel replies that the opinion of the witness is asked as derived from his general scientific knowledge as a chemical expert.)

A. From the experiments I have made, down as low as 212° Fahr. and slowly to take place at ordinary temperatures of the atmosphere.

X Q. 153. Then I understand you to say that from 300° Fahr. to over 612° Fahr. the chemical action of water upon fat, to produce fat acid and glycerine, is substantially the same. Is that so?

A. That is so.

X Q. 154. Does not this action become more powerful, in the
782 sense of becoming more rapid, in proportion as the heat is increased?

A. It does.

X Q. 155. At what point of temperature, if any, in descending from 612° Fahr. to 300° Fahr., would you, as a practical chemist, assert that this operation ceased to be one and the same chemical process?

(Counsel for defendants inquires of complainant's counsel whether he uses the words "chemical process" as synonymous with patentable process, or whether by the expression he means simply to inquire if the same result' are accomplished under the different conditions named?

Counsel for complainant replies that he uses the expression "chemical process" in the sense in which it is generally understood by practical chemists and manufacturers.)

A. At no point.

Here adjourned until 9 a. m. Saturday, July 3d, 1869.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

Met pursuant to adjournment.

X Q. 156. Were any processes for manufacturing fat acids practically worked as a manufacturing operation prior to 1854, except the lime-saponification process and the process of sulphuric acid combined with distillation?

A. Not that I know of.

X Q. 157. In the process by sulphuric acid combined with distillation, was the glycerine destroyed?

A. It was.

X Q. 158. In the experiments made by Mr. Fennel and yourself in the paraffine-bath, were the tubes containing the materials operated upon kept in a vertical or horizontal position during the operation?

A. They were kept in a horizontal position.

X Q. 159. Were they agitated during the operation?

A. They were not.

X Q. 160. Describe the appearance and consistency of the product of these operations when the fat and water alone were
783 used, and also when lime-soap was used in addition to hot water.

A. The appearance when lime-soap was used was similar to the mass previously described as taken from the defendants' digester process, and the consistency was like thin mortar, which became stiff upon cooling. When water alone was used the fat and water separated on pouring out the contents of the tube, and the appearance of the fat was slightly altered in color, bleached, and the water had a slight opalescence.

X Q. 161. I understand, then, that when lime-soap, fat, and water were used, all these substances were mixed together in a homogeneous mass in the product as it came from the tube—is that so?

A. That is so.

Witness states: That I answered cross-question 156 with this understanding: Did I know of any other processes than those mentioned of being practically carried out? I said I did not, but do not wish to be understood to say that others were not known and used; whether they were practically carried out to any extent or not I cannot say.

X Q. 162. In defendants' original answer herein it is stated that after the lime, fat, and water in their digester had been exposed to the temperature of about 300° Fahr., and pressure of about 75 pounds, during about six hours, the steam is shut off and the contents are allowed to stand from about twelve to fifteen hours. At the end of this time is the glycerine-water entirely separated, or is it, to some extent still blended through the mass of fat acid and lime-soap?

A. The glycerine is not all separated. It is in solution in water; and this mixture, to some extent, is mixed mechanically with the mass of lime-soap and acid.

X Q. 163. Is the same true of the product of defendants' process as described in their supplementary answer?

A. It is.

X Q. 164. Referring to Question 19 in chief, do you mean to say that if you had not possessed any previous knowledge of the fact of the decomposition of the fat into free fat acids and glycerine by water at a high temperature and pressure, you would certainly have become acquainted with that fact by reading Defendants' Exhibit No. 1?

784 A. I do say so.

X Q. 165. Please quote the words of said exhibit which announced the fact that fat can be decomposed into free fat acids and glycerine by water at a high temperature and pressure?

A. The exhibit does not say change of fat by Perkins' engine by the action of water, heat, and pressure, into fat acids and glycerine; it merely alludes to a change of fat. Upon the examination of the report, and the knowledge I have of the decomposition of fats by heat and water, the only inference I can form is from the facts mentioned in the paper, that both fat acids and glycerine were produced in the decomposition or change named.

X Q. 166. Your last answer shows a misconception of cross-questions Nos. 164 and 165 in two essential points. 1st. You were not asked what you now believe to have been formed in the fat used in Perkins' engine, but only, exclusively, what Exhibit 1 itself states to have been formed in said fat; and, 2nd, you were to suppose yourself entirely ignorant of the fact, now notorious, that fats can be decomposed into free fat acids and glycerine by the action of water at a high temperature and pressure. I therefore now ask you whether it is anywhere plainly and intelligibly announced in Exhibit 1 that fat can be decomposed into free fat acids and glycerine by the action of water at a high temperature and pressure, and, if so, to quote the words of such plain and intelligible announcement.

A. The exhibit states to have been produced by the combined action of water, heat, and pressure on fat, a decomposition; and further, that the fat thus changed resembles Chevreul's acid of fats. Glycerine is not mentioned as a product of this decomposition in the article.

X Q. 167. Is that word "decomposition" anywhere used in said exhibit in describing the "change of fat?"

A. The word "decomposition" is not used in describing the change of fat.

X Q. 168. Is not your answer to cross-question 166 also incorrect in saying that Exhibit 1 states "further that the fat thus changed resembles Chevreul's acid of fat?" Does not the exhibit merely state that a certain "gray substance obtained from the changed fat" dissolves readily in alkalies, more readily, I think, than fat, and in this respect "resembles Chevreul's acids of fat, as well as in its solubility in alcohol?"

785 A. Upon reading over the paper carefully, I find that the term "resembles Chevreul's acid of fat" is used in relation to that portion of the changed fat that separated upon cooling from the alcoholic solution of the whole mass thus changed. And the resemblance was in this respect: its solubility in alcohol and dissolving in alkaline solutions.

X Q. 169. Is it anywhere stated in said exhibit that the "changed fat," or any product from it, "resembles Chevreul's acids of fat" in any other respect than "solubility in alcohol, and dissolving in alkalies more readily, I think, than fat;" if so, quote the words?

A. No; it is not.

X Q. 170. Are there not other properties of the "grayish substance" mentioned, namely: "That it does not melt in boiling water, but at a higher heat melts and ultimately burns like fat." And that "it is not soluble in ether, or very slightly so?"

A. Those properties of a grayish substance are mentioned.

X Q. 171. Did you ever see, hear, or read of any acids of fat, obtained from oil or tallow, which would not "melt in boiling water," and which was "not soluble in ether, or very slightly so?"

A. No.

X Q. 172. Would chemists generally recognize as fat acids of oil and tallow (meaning thereby free fat acids) a substance which is described as being soluble in alcohol and in alkalies, but not melting in boiling water, and insoluble in ether, or nearly so?

A. They would not.

X Q. 173. Is it stated in said exhibit that any other portion of the "changed fat" besides the "grayish substance" resembles Chevreul's acids of fat? If so, quote the words.

A. It is not.

X Q. 174. As a matter of chemical history and information, did chemists generally become informed from Exhibit 1 of the fact that fats could be decomposed into free fat acids and glycerine by the action of water at a high temperature and pressure?

A. They could have; whether they did or did not I cannot say.

786 X Q. 175. When was Exhibit 1 first brought to your notice as a chemical expert on behalf of defendants in this suit?

A. In February, 1868.

X Q. 176. Please look at the list of chemical and technical treatises mentioned by Prof. Booth in answer to Questions 68 and 69 of his examination-in-chief as a witness for complainant in this suit; state whether said treatises are works of standard authority.

A. They are; but in regard to Regnault's Chemistry, his authority in one fact is faulty. Booth and Faber's edition, on page 686, in relation to fatty acids, mentions "they are feebly soluble in ether." This is not so.

X Q. 177. Is it anywhere plainly and intelligibly announced in Defendants' Exhibit No. 9 that free fat acids and glycerine were produced from the oil, by the action of water at the temperature and pressure of the atmosphere? If so, please quote the words of such announcement.

A. It is not announced in Exhibit No. 9 that free fat acids were obtained, but mentions "upon the top of this, in various parts, were drops of aqueous fluid, of a tenacious consistence, which had a very decided sweet taste, and resembled the substance which is formed during the process of saponification, to which the name of glycerine has been given." Nevertheless, if glycerine was produced, so, also, must have been free fat acids.

X Q. 178. Suppose that a soap had been produced in the oil, would not glycerine have also been produced?

A. There is no alkali mentioned as being present in the oil and water in the exhibit above mentioned, consequently a soap, so called, could not have been produced; but there is no question, if there had been an alkali, so as to produce a saponification by its agency, as in the formation of soaps by means of the decompositions of fats, in the ordinary manner, glycerine would be also produced.

X Q. 179. I understand, then, that Exhibit 9 does not mention plainly and positively that either fat acids or glycerine was produced; is not that so?

A. Not in so many words, but so plainly, I think, that any chemist would understand such to be the case.

787 X Q. 180. Have you any proof that Daniell himself, the author of Exhibit 9, understood that free fat acids and glycerine were produced in said experiment by the action of water on fat at common temperatures and pressures?

A. From the fact that he mentions a sweet substance resembling glycerine, in speaking of the change, he certainly must have had a knowledge of the composition of fats, and the products of their decomposition. I think from his remarks that he did know that such change had taken place, (that is, fat acids and glycerine.) This is the only proof I can offer.

X Q. 181. Will fat acids corrode metallic surfaces, (copper, iron, and brass,) when kept a long time in contact with them in the air?

A. They will, slowly—more rapidly if heated.

X Q. 182. If, therefore, the oil, in Exhibit 9, had been converted into free fat acids, any metallic surfaces of brass, iron, or copper, which had been in contact therewith, during a long time, would have been corroded, would they not?

A. The word "corrosion" here used, to some, would imply a rapid and destructive action upon the metals named, (I mention this in explanation of the use of the term;) such rapid corrosion would not take place with the fat acids. They certainly would act upon the metals corrosively, but very slowly; and that they did thus act would be shown more clearly from the color of the fat acids than from any corrosion evident upon the metallic vessel containing them.

X Q. 183. Do you wish to be understood as asserting, as a chemist, that a surface of copper, or brass, would remain "bright," and "with no signs of metallic corrosion in any part," after remaining for several months in

the air at common temperatures in contact with the free fat acids of castor-oil?

A. The case is a supposed one. I would say that a flat surface of copper or brass could be thus exposed for several months, covered with merely a film of fat acids, or as much as would remain on the surface of the metal, that in the time mentioned, a solution, or corrosion of the metal, on its whole surface, thus exposed, would take place.

Here adjourned until 10 a. m., Monday, July 5th, 1869.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

788 Met pursuant to adjournment.

X Q. 184. Do you understand that the oil set by with water in a glass vessel (as described in Exhibit 9) had also become decomposed, in whole or in part, into free fat acids and glycerine?

A. Only in part.

X Q. 185. What proof do you find in the exhibit that it was in part decomposed into free fat acids and glycerine?

A. I have no proof; it is supposition on my part.

X Q. 186. What proof have you in Exhibit 9 that free fat acids existed in the oil, in the cistern of the barometer?

A. To me the substance of a sweet taste mentioned is evidence that glycerine was present, and that fat acids must have been also present; for neutral fats cannot be deprived of their glycerine, or glycerine be produced from them, without a corresponding amount of free fat acids being formed.

X Q. 187. Have you not already admitted that the presence of glycerine could be explained as well by the supposition that a soap had been formed in the oil, as by the supposition that free fat acids had been formed in the oil?

A. I have; but I find mention of no substance mentioned in Exhibit No. 9 that would lead me to think that a soap had been formed and a glycerine a result of the saponification.

X . 188. When glycerine is produced in the decomposition of fats by water, where is the glycerine found? Is it found dissolved in the water, or separate from the water?

A. It is found dissolved in the water.

X Q. 189. Do you find any proof in Exhibit 9 that there was any glycerine found dissolved in the water?

A. The oil does not appear to have been agitated with the water, but resting upon it; the vegetable fats always contain more or less moisture, and this alone sets up a decomposition of them, and as the result of their decomposition fat acids and glycerine would be found as a mixture; in palm-oil, for instance, this decomposition takes place to a considerable extent; consequently I can conceive that a decomposition of the castor-oil might take place and the glycerine be not all dissolved in the water below it, but be mixed with the fat, and the glycerine as an exudation of the mass be found on the top of it.

789 X Q. 190. Then, why did not the same decomposition of oil and formation of glycerine on its top take place in the glass vessel?

(Objected to as assuming that there was no decomposition in the glass vessel, whereas said exhibit states as follows: "At the point of contact with the water, it appeared to have undergone change, and to be separated from it by a tough film of the same mucilaginous-looking substance which we had found in the water.")

A. There appears to be a difference in the condition in the experiment Heat was present in one case, in the other none. The heat may have facilitated the decomposition in the barometer, in the experiment with the glass vessel. The decomposition, consequently, would not be so rapid as in the other, and if any change or decomposition had taken place, the same results would have followed as in the other, and the examinations made of it are so very imperfect that, if there had been present any glycerine or fat acids, it could not have been known from them.

X Q. 191. What degree of heat do you understand from Exhibit 9 to have been used in the experiment in the barometer?

A. I say, from Exhibit 9, I cannot make out. If I had the whole report of which this is an extract, I could probably.

X Q. 192. What, then, do you mean by saying in your last answer, "There appears to be a difference in the conditions in the experiments. Heat was present in one case, in the other none. The heat may have facilitated the decomposition in the barometer?"

A. As mentioned before, I cannot make out the exact conditions in which the oil was placed, from the extract as contained in the exhibit. I might infer from it, however, that the oil must have been heated more or less above the atmosphere. Consequently, I said that the oil in the barometer was exposed to a different condition of things from the oil in the glass vessel.

X Q. 193. How long a time do you understand from Exhibit 9 that this heat was applied to the oil in the barometer?

A. I do not find the time stated. I cannot make out the time.

X Q. 194. What is the impression in your mind on this point, under which you have answered the questions herein, relating to this exhibit?

790 A. From my knowledge and experience in handling castor-oil, I would say that, in the conditions in which the oil was placed in the glass vessel, that this change, as mentioned would not take place rapidly, but that placed in the barometer, if it was heated at all, (which I suppose it was,) the change would be more rapid than the other; but, in both instances, some time would be required to cause the decomposition; how long or how short, I cannot say.

X Q. 195. Question repeated.

A. I cannot say how long a time the heat was applied to the oil.

X Q. 196. In answering the questions herein, had you any idea in your mind as to what degree of heat was applied to the oil in the barometer, and for how long a time?

A. I had no idea how much was applied, nor for how long. I supposed it was heated, (from the text,) and not to the boiling-point, but for how long, I have no idea.

X Q. 197. What length of time do you understand to have elapsed between the time when the oil was placed in the barometer and the time when the substance resembling glycerine was found in it?

A. It was put in on the 18th of June; how long before the change in the oil was noticed to have taken place is not stated. I know nothing about the length of time.

X Q. 198. Do you understand the "mucilaginous-looking substance" mentioned in Exhibit 9 to have been the free fat acids of castor-oil?

A. I do not.

X Q. 199. What do you understand said "mucilaginous-looking substance" to have been?

A. It may have been albuminous matter separated from the oil, which separation will take place when castor-oil and water are mixed to-

gether. Castor-oil thus treated will become slowly rancid, and will increase in rancidity by time. This mucilaginous matter will separate and form a layer between the oil and water.

X Q. 200. Where do you understand the "drops of aqueous fluid," mentioned in Exhibit No. 9, to have been found? Were they on top of the oil or between the water and the oil?

A. In Exhibit No. 9, from the text, it appears that the sur-
791 face of the oil was covered with large clots of a mucilaginous-looking substance which reached quite through to the water beneath. It was then apparently on top of the oil.

X Q. 201. Your idea, then, is that the supposed decomposition of the oil was produced by the moisture naturally present in the oil, and not from the water below the oil; is that so?

A. Partly in each way; if there was any steam above the surface of the oil, or any vapor of water, it would also exert an influence.

X Q. 202. The supposed glycerine formed on top of the oil must all have been produced by some different water or moisture from the water below the oil; must it not?

A. I should say so; although the water below might assist in the decomposition. If no water at all had been present, other than that accidentally in the oil, I should then positively say that the glycerine present had been formed by that water.

X Q. 203. Can you produce any publication of date earlier than January 9th, 1854, which states plainly and intelligibly that fats or oils can be converted into free fat acids and glycerine by the action of water at atmospheric temperatures and pressures?

A. I do not know of any publication stating that fact, in so many words; but it is a well-known fact, observed and known, prior to that date, that the presence of moisture in fats will cause them to change and become acids, (fat acids;) and no such change, I understand, can take place without a corresponding amount of glycerine being produced; consequently, whether the fact was so announced or not, it is a fact, nevertheless, and known prior to 1854.

X Q. 204. Is the change you allude to, as being long known, the change commonly known as the rancidity of fats and oils?

A. That is what I allude to.

X Q. 205. Was the explanation of that change contained in Dumas' Chemistry, vol. 6, p. 569, (agreed extract now produced,) generally received and adopted by chemists prior to 1854? If not, can you produce any different explanation from any standard chemical authority?

A. It was; and I cannot make any different explanation. The facts are stated as I understand them to be, and I have made my previous answer on that basis.

792 X Q. 206. Has it been generally known to chemists, and published in standard chemical treatises, prior to 1854, that solutions of alkaline carbonates would form soaps with neutral fats, by long boiling therewith, at 212° Fahr.? If so, please describe the successive stages of the operation.

A. It has; one portion of the carbonated alkali is decomposed, and the carbonic acid thus liberated forms a bicarbonate with another portion of the alkali, which bicarbonate is decomposed at a boiling-heat, and this action and re-action continues until the end of the process.

X Q. 207. State whether the process of lime-saponification, generally used by manufacturers, prior to 1854, was substantially the process described by M. Werk, in his answer, filed 6th of January, 1860, in the former suit of Tilghman against Werk, (page 9, lines 20 to 28, com-

plainant's printed record in suit of Tilghman against Werk,) as having been used by him and other manufacturers in Cincinnati since 1841.

A. I believe the process described by M. Werk, in his said answer, not to be the process generally used. I am satisfied, from my own knowledge, that other parties were using less lime; how much less, I am not positive, but would say as small a quantity as ten or eleven pounds to the hundred pounds of fat used. It is also mentioned in the report of the juries of the London exhibition, in the year 1852, page 621, that from 10 to 15 parts of quicklime are added, for every 100 parts of tallow in the lime process, as practiced at Messrs. Ogleby & Co.'s works, at Lambeth. Many manufacturers, however, used, as stated by M. Werk, 14 pounds of lime to 100 pounds of fat.

X Q. 208. Please examine page 90 to 100 inclusive, of complainant's printed record, in said suit of Tilghman against Werk, now produced and marked Complainant's Exhibit, Wayne, No. 1, L. H. P., and pages 45 to 54 inclusive of defendant's printed record, in said suit, and now produced, marked Complainant's Exhibit, Wayne, No. 2, L. H. P., and state whether you gave the testimony therein contained, as a chemical expert, for the defendants in said suit.

(Counsel for defendants inquires of complainant's counsel the object of the "production" of said testimony, and whether complainant's counsel desires and intends to offer the same in evidence, and if so, for what purpose.

793 Counsel for complainant declines to make any response to the inquiry.

Counsel for complainant declining to make any response to said inquiry, the counsel for defendants hereby enters his protest to the proposed "production" of said testimony, on the ground that the same is a useless encumbering of the record in this cause; further, that such testimony could only be competent for the purpose of impeaching the witness, and for that purpose could not be introduced in the manner proposed; and complainant's counsel is notified that prior to the hearing of this cause, for the reasons stated, motion will be made to the court to strike said proposed testimony from the record at complainant's cost.

Complainant's counsel states that he offers said testimony in evidence for all purposes for which it is competent.

Counsel for defendants replies that it is competent for no purpose, and hence renews his objection, and will move the court, as stated, to strike it from the file.

A. I did.

X Q. 209. Where the experiments heretofore described by you, in answer to the sixth question-in-chief, as being made in defendants' digester at their factory, made in the form of the digester described in their original answer, or in the form of the digester described in their supplemental answer herein?

A. The experiments, as described, were made in the apparatus described in the supplemental answer.

X Q. 210. Did you ever analyze by the methods approved by chemists the "emulsive compound" mentioned by you in answer to cross-question 45, to ascertain whether it was or was not a mixture of neutral fat neutral lime-soap, and free lime?

A. I have not made a finished analysis of the same; it was my intention to have done so, but other matters prevented my so doing.

X Q. 211. Can you produce any publication of date prior to January 9th, 1854, in which it is plainly and intelligibly stated that fat can be

decomposed into free fat acids, by the action of steam in any other way than by the process of distillation?

A. I cannot.

X Q. 212. Which has chemically the stronger acid properties, stearic acid or oleic acid?

A. Stearic acid.

794 X Q. 213. Will free stearic acid, heated with oleate of lime and water, form stearate of lime and free oleic acid?

A. I think it will.

Re-examined by Chas. B. Collier, esq., attorney for the defendants:

Q. 214. What are the relative proportions of stearic and oleic acids obtained from tallow?

A. About equal proportions.

Q. 215. Calling your attention to cross-question 75, and the answer thereto, do you mean to convey the impression that where lime, fat, and water are heated together, the lime being in quantity, say, 4 or 7 per cent. of the fat, no decomposition of the lime first formed will take place?

A. I do not mean to convey such impression.

Q. 216. Did the experiment made by you, as referred to in cross-question 76, prove, or tend to prove, that decomposition of lime-soap under the conditions named in the last above question would not take place?

A. It did not intend to prove such fact.

Q. 217. Is it not the theory of Pelouze, as stated in his paper "upon the saponification of neutral fatty bodies by the soaps," that when lime is used in less quantity than sufficient to form neutral soap with the entire mass of fat, decomposition of the soap first formed takes place?

A. It is.

Q. 218. What is the reputation and standing of Pelouze, as a chemist, in this branch of chemistry?

A. He is regarded as one of the foremost.

Q. 219. From the fact as proven by your own experiments, as to the action of lime-soaps upon neutral fats, do you not consider the theory as advanced by Pelouze a natural and correct one?

A. I consider it a very plausible one, and in my mind a correct one.

Q. 220. Does not the statement of Pelouze, contained in his paper, in the following words: "I have besides assured myself that at the temperature of 165° C. (329° Fahr.) water does not act upon the

795 oils," accord substantially with the result of your own experiment, taking into consideration the time mentioned by Pelouze, to wit, very nearly three hours?

A. Water alone, at and below the temperature named, very slowly decomposes the fats, so much so that for industrial processes in the manufacture of fat acids it is worthless, and his statement accords with *with* my experiments.

Q. 221. In cross-question 133, you were asked whether you have ever seen any publication of date earlier than Wilson and Payne's patent, July 24th, 1854, in which glycerine is explicitly mentioned to be a product of the distillation of fats by superheated steam, to which you answered in the negative. Please look at Defendants' Exhibit No. 8, published in Paris in 1851, and state whether it contains such explicit announcement.

A. I have examined the exhibit and find it does.

Q. 222. Calling your attention to the paragraph quoted by you from the "reports by the juries," published in 1852, descriptive of the lime

process, as practiced by Messrs. Ogleby & Co., will you state whether the minimum quantity of lime stated to be used in said process, to wit, 10 per cent., would be sufficient to form a neutral lime-soap of the entire mass of fat?

A. It would not.

Q. 223. If, in such process, with such minimum quantity of *of* lime, decomposition of the entire mass was effected, would there not be a portion of free fat acid produced as well as glycerine?

A. Yes, there would be.

Q. 224. From the experiment as made by you in the open tub of the defendant, employing water and steam, and no lime, and from the result thereof, what is your opinion as to whether or not total decomposition of the fat was effected by Messrs. Ogleby & Co., with 10 per cent. of lime?

A. I should say that it was all decomposed.

Here adjourned until 9 a. m., Tuesday, July 6th, 1869.

LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

796 Met pursuant to adjournment.

Q. 225. Assuming that the complainant, Mr. Tilghman, was the discoverer of the chemical power of water to decompose fats, is there anything in his said letters-patent, in your opinion, which would lead any one to infer that water possessed such chemical power at any less temperature than the minimum named in his said patent, to wit, 440° Fahr.?

A. There is not.

Q. 226. Have you made any experiment which enables you to say that glycerine of fats will not be destroyed in the practice of the process as described in the complainant's patent?

A. I have not.

Q. 227. Calling your attention to the extract from Dumas' Chemistry, relative to the rancidity of fats, will you please state whether the change in the oil in Daniell's barometer (Exhibit No. 9) was such a change as contemplated and described in said extract?

A. The oil used in the experiment in the barometer, also in the glass vessel in the account here given, does not appear to have undergone the change in fats mentioned by Dumas. In the glass vessel "the great body of it was perfectly bright and pure, and did not seem from its taste to have undergone any change or to have acquired any rancidity." In the barometer there is no mention of the condition of the oil. I should say, however, that I should not think that it could have become rancid, for the rancidity of fats requires a long time to be brought about.

Q. 228. Calling your attention to cross-questions 170 to 174, relative to Perkins' engine, will you please state what evidence, if any, there is in Exhibit No. 1 of the decomposition of the fat into fat acids, other than that contained in that part of said exhibit to which your attention was especially called in said cross-questions?

A. The evidence I have is from the analysis given by Faraday, that there was free fat acid besides the soap mentioned in the mass that he examined. I will take up the report of his analysis now: "A portion of this substance was digested in hot alcohol and the clear solution set aside; flocculi separated in abundance from it on cooling, which,
797 when dried, collected, and fused, gave a grayish substance, contracting and cracking as it cooled with the lustre and appearance

of wax, but rather more brittle. It does not melt in boiling water, but at a higher heat melts, and ultimately burns like fat. It is rather lighter than water. It dissolves readily in alkalies; more readily, I think, than fat, and in this respect resembles Chevreul's acid of fat, as well as in its solubility in alcohol. The alkaline solution is turbid. It is not soluble in ether, or very slightly so. When burnt it leaves an ash consisting principally of carbonate of lime."

Further, in the report of the analysis it is said: "The cold alcoholic solution on evaporation left a substance similar in many respects, but much softer, even fluid; is burnt in the same manner, leaving a slight ash of carbonate of lime."

The cold alcoholic solution, then, after the disposition of the grayish mass described, contained a substance similar in many respects to the grayish mass, but softer, even fluid; and when burnt, left a slight ash of carbonate of lime. Now this substance was really the fat acid of Chevreul, and free fat acid, the same as is produced in defendants' digester, and, like it, contained a trace of lime, as is present in all fat acids where lime is present in the change or decomposition of fats. This is a proof, then, that there were fat acids free and existing beyond the fat acids contained in the grayish substance, which substance was, in fact, a soap of the metals and of lime and fat acids.

Q. 229. Having stated in your cross-examination that you could not produce a publication of anterior date to the complainant's patent, in which it is plainly and intelligibly stated that fats can be decomposed into fat acids by the action of water at high temperature and pressure, I will ask you now whether, from the facts as stated in Exhibit No. 1, such decomposition would not be inferred by any chemist practically acquainted with the decomposition of fats, and having no knowledge, whatever, of complainant's patent?

(Objected to as leading.)

A. I would say that the announcement of the facts mentioned in Exhibit No. 1 are such that would plainly point out to any chemist that fats can be decomposed, as therein mentioned, by heat, water, and pressure; and whether it could be turned to practical use or not would be the only question to solve.

798 Q. 230. Calling your attention to cross question 206, and the answer thereto, in which you state that it has been known that solutions of alkaline carbonates would form soaps with neutral fats by long boiling at 212° Fahr., will you please state to what alkaline carbonates you had reference?

A. Carbonates of potash and soda.

Q. 231. Calling your attention to section 3, page 13, letters-patent of Radley & Meyer, (Defendants' Exhibit No. 10,) are you able to state from your experiments, and if so, will you please state what would be the resulting products if "pultaceous animal refuse separately," with the minimum quantity of lime (to wit, 2½ per cent.) mentioned in said patent, was treated in the "atimo-dynamic digester," as described in said section?

A. If the pultaceous animal refuse contained in them more fat than would have combined with the 2½ per cent. of lime, to form lime-soap with the fat acids, the fat would produce, by its decomposition, free fat acids, and lime-soap would be the result. If less fat, and only sufficient to combine with the lime, a neutral lime-soap would be formed. Either of the results might follow, depending upon the amount of lime and fat present.

Recross-examined by B. C. Tilghman, esq., counsel for the complainant:

X Q. 232. In said patent of Radley & Meyer, is it anywhere stated that any free fat acid, or any acid-soap, was produced by the treatment, either of fats, or of bones, or of pultaceous animal refuse, with any proportion of lime, (large or small,) in either open or closed vessels, and either at common boiling point, (212° Fahr.,) or at high temperatures and pressures? If so, please quote the words.

A. Free fat acids are not mentioned in the patent of Radley & Meyer.

X Q. 233. In Gmelin's Chemistry, London, 1865, vol. 17, page 70, it is stated, "oleate lime melts at a gentle heat and becomes transparent; dissolves in alcohol and ether." In your laboratory, when treating with alcohol the neutral lime-soap obtained in the experiment by order of the court, did you obtain oleate of lime from the alcoholic solution, agreeing substantially with the above description? Describe the product you did obtain.

799 A. It has been so long since I performed the analysis that I cannot say what the properties of the substance were that I obtained.

X Q. 234. From your general chemical knowledge, is the fact as above stated, from Gmelin's Chemistry, substantially true or not?

A. Never having performed the experiment on pure oleate of lime, and never having seen it, I cannot say, of my own knowledge. Gmelin is a recognized authority, but nevertheless, I would say that I should prefer to test the fact before taking as granted the fact mentioned.

X Q. 235. Have you any authority to the contrary?

A. No, I have not. Pure oleic acid is a rare product; I do not think a lime-soap of it is soluble to any considerable extent in cold alcohol.

X Q. 236. Have you not treated neutral lime-soap made with 11½ per cent. of lime (under order of the court) with benzine, alcohol, or other solvents, and evaporated the clear solution thus obtained?

A. Yes.

X Q. 237. Was not the product resulting from said evaporation a very soft or fluid substance?

A. I have said in answering a former question that I did not remember the analysis, but since then, in conversation, the matter has been recalled to my mind, and my recollection now is that I did so treat the soap, and found a small portion of an oleate soap taken up. It was a soft substance, fluid by heat, and the analysis of it shows that it was a lime-soap; the appearance of it cold I have no recollection of.

X Q. 238. If neutral lime-soap be digested with hot alcohol, and the solution left to cool, and the clear cold alcoholic solution be evaporated, what will be the substance left from that evaporation?

A. A small quantity of a neutral oleate, or stearate of lime-soap.

X Q. 239. Can you swear that the soft substance left by evaporation of the cold alcoholic solution, mentioned in Exhibit 1, certainly was not such, or a similar neutral oleate and stearate of lime, or other base?

800 A. I cannot swear so. I do not believe it was a neutral stearate and oleate of lime. The report of the analyses of both the flocculi, and the deposit left after evaporating the cold alcoholic solution, is so different in regard to the amount of lime found in them, that I can but believe that the fat left by the evaporation of the alcohol contained more or less free fat acid.

X Q. 240. When previously examined as a chemical expert, in relation to complainant's patent, were you asked the following question: "State whether by the process of Mr. Werk, using 7 pounds of lime to

100 pounds of fat, and 130 pounds of water, any free fat acid is produced; if yea, is it separated from the lime-soap, or does the substance he produces undergo any other, and what, process to separate the fat acid, so as to make it a free fat acid fit to use as such;" and did you make the following answer thereto: "I do not think there is any free fat acid produced by Mr. Werk's process; the substance he produces must be decomposed by sulphuric acid, so as to make a free fat acid?"

A. I answered the question then so, and qualifiedly think so now chemically, and, as a final result, lime-soap and free fat acids are produced, but there is no free fat acid produced that any practical use can be made of. The process, as a manufacturing one, produces really no free fat acids.

X Q. 241. Were you then asked the following question: "Suppose you submit lime-soap to a high temperature of water under pressure, what will be the result? What will be the result if you add fat to the lime-soap, and submit to the same temperature and pressure?" And did you make the following answer: "I do not think any decomposition, under the circumstances, will take place. I do not think any saponification will take place in either case. There will be no decomposition of the lime-soap?"

A. If I answered the question as therein stated, I did it through error. The error is in answering: "What will be the result if you add fat to the lime-soap, and submit to the same temperature and pressure." Decomposition of the fat would unquestionably take place. I was aware of the fact of the decomposition of fats by the lime-soap when I made my former answer. With lime-soap and water alone there would be no decomposition.

801 X Q. 243. Were you then asked: "Supposing that highly-heated water, under pressure, would decompose fatty bodies into fatty acids and glycerine, can you state positively that the presence of a small proportion of lime would prevent the action taking place?" And did you make the following answer: "It would not prevent that action taking place?"

A. I did make that answer; but would further add, now, that any quantity of lime added would produce a corresponding amount of lime-soap, and facilitate the decomposition of the whole amount of fat, at a lower temperature and pressure, than if not used.

X Q. 244. Were you then asked the following questions, and did you make the following answer: "Question 24. Are you certain that the reduction of lime required in the process of Mr. Werk, and the others named by you, is not owing to the chemical power of the highly-heated water under pressure, which is present in their processes?"

"Answer. I am certain that the reduction of the lime is not due to the chemical power of the highly-heated water in decomposing the fatty bodies."

"Question 25. Why are you certain?"

"Answer. My impression is that in the first instance there is a highly basic lime-soap formed, which is decomposed by the action of water or steam at high temperatures, a mutual decomposition and recomposition of that lime-soap taking place until a perfect saponification or acidification of the fat takes place through the whole mass, and the resulting fat acids may be, as I judge, an acid lime-soap, or neutral lime-soap and free fat acid. And the chemical action of the water is to the greatest extent exerted in decomposing the lime-soap as mentioned, and not upon the fat. Now, it is well known that the elements of water must be taken up by the fat bodies to convert them into fat acids and

glycerine, which takes place in either case, with lime or without lime; and the rapidity with which fat bodies can be converted into fat acids and glycerine, by the process of Werk and others, show conclusively that the saponification is due to the lime and not to the water.

"In an experiment made by Mr. Cheever, by using seven pounds of lime, with highly-heated water, under a pressure of 350 pounds to the inch, perfect saponification resulted in half an hour.

802 "If, as mentioned, fifty per cent. of Mr. Werk's free fat acid is produced by lime, and the other half *of* the action of heated water; judging from the experiment of Cheever and at Ropes', the use of lime certainly *exacts* the chemical decomposition?"

A. I did so answer those two questions; I might modify them now to a certain extent, but would merely say, in the decomposition of the lime-soap alluded to in answer to Question 25, the lime-soap there mentioned as being decomposed was not a neutral lime-soap but a highly acid or basic one, supposed to be formed.

X Q. 245. Were you then asked the following questions, and did you make the following answers:

"Question 36. Referring to your first examination in this case, is there anything in your answer to Question 3, by defendants' attorney, that you would wish to correct?"

"Answer. Yes there is. The question is: 'Have you known that free fat acids and glycerine can be produced by heat and water alone; if yea, how long since have you ascertained this; if from scientific works, state the names of the works and publications, when made, and where published; if you have any practical knowledge, and say when and where.' My answer now, is, I have never practically manufactured stearic acid, or been engaged in the business, but I have frequently been consulted on the subject by manufacturers engaged in the business, and could practically carry on the process. I was in error when I stated formerly that the production of free fat acids and solution of glycerine was mentioned by Payen's Chemistry, 1851, also in Regnault's Chemistry."

"Question 37. Mention your authority for your opinion expressed, in your Answer No. 2, question by defendants' attorney, that stearic acid is tribasic acid, and will combine with one, two, or three equivalents of a base."

"Answer. I wish to strike out the word tribasic in said answer, and insert triacic compound in lieu thereof."

"Question 38. Please state whether the formulas of stearic acid, given at the close of that examination, are those of tribasic or merely three equivalents of a monobasic acid, and whether you wish that statement to be retained as an expression of your views?"

"Answer. They are three equivalents of a monobasic acid; I do not wish that statement retained as my opinion."

803 (Counsel for defendants inquires for what purpose the said questions and answers of the witness, as contained in said original suit, are referred to.

Counsel for complainant replies that they are referred to for all purposes for which they are competent.

Counsel for defendants enters the same objection and protest thereto, as heretofore made.)

A. I did make the above answers to said questions.

E. S. WAYNE.

STATE OF OHIO, *County of Hamilton, ss:*

I, L. H. Pummill, a notary public within and for the county of Hamilton, in the State of Ohio, do hereby certify that J. Lawrence Smith and Edward S. Wayne were by me duly cautioned and solemnly sworn to testify the truth, the whole truth, and nothing but the truth, and that the depositions by them subscribed respectively, as above set forth, were (with the exception of that part of the deposition of J. Lawrence Smith which follows in cross-question 115, to the conclusion of the testimony) reduced to writing by me, in the presence of the witnesses respectively, and by them respectively subscribed in my presence. And as to that portion of the deposition of J. Lawrence Smith, from cross-question 115 to its conclusion, the same was taken at Louisville, Kentucky, pursuant to agreement between the counsel for complainant and defendants, which agreement is herewith returned. I do further certify that I have, in person, delivered said testimony to the clerk of said court.

[L. S.] LEONIDAS H. PUMMILL,
Notary Public, Hamilton County, Ohio.

804

805 Circuit court of the United States, southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN Kirby, and M. Schwartz. } No. 1018. In equity.

Deposition of B. Howard Rand, taken on behalf of the defendants in the above-entitled cause, before me, Joseph T. Ford, a notary public within and for the county of Philadelphia, in the State of Pennsylvania, at the office of Charles B. Collier, esq., No. 713 Sansom street, in the city of Philadelphia—such testimony having been commenced on the 12th day of August, 1869, and continued by adjournment from day to day as hereinafter noted.

THURSDAY, *August 12th*—10 a. m.

Present, Benjamin C. Tilghman, esq., on behalf of complainant; Charles B. Collier, esq., on behalf of defendants.

B. HOWARD RAND, being first duly cautioned and solemnly sworn, deposes and says as follows:

Question 1. Please state your name, age, place of residence, and occupation?

Answer. B. Howard Rand, M. D.; aged forty-one years; residence, 1615 Summer street, Philadelphia; I am professor of chemistry in Jefferson Medical College.

Q. 2. What posts, if any, in public institutions have you held?

806 A. I was lecturer on chemistry at the Franklin Institute, from 1853 to 1862; professor of chemistry in Philadelphia College of Medicine, 1853 to 1858; in the medical department of Pennsylvania College, 1859 to 1861; in the Central High School, 1859 to 1864; and since 1864 in the Jefferson Medical College.

Q. 3. Are you acquainted with the various processes of manufacturing fat acids and glycerine and preparing fats for manufacture into candles; if yea, what have been your opportunities for obtaining such information?

A. I believe that I am acquainted with the various processes alluded to in the question. I have acquired my knowledge by reading and by experiments.

Q. 4. Have you read, and do you understand the letters-patent granted to Richard A. Tilghman, October 3d, 1854, No. 11766, entitled "A new and useful improvement in processes for purifying fatty bodies;" if yea, what improvement do you understand to be therein described and claimed?

A. I have carefully read and examined said letters patent, and believe that I understand the same. The said patent, as understood by me, describes a process for treating fatty matters—that is, fats and oils—by submitting them to the action of water at a high temperature and corresponding pressure, so as—using the words of the patent—"to cause the elements of these bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine."

Q. 5. Have you read, and do you understand, the processes of the defendants as described in their original and supplemental answers in this cause?

A. I have read the descriptions, and do understand the processes named. The process described in the original answer consists in subjecting a charge of fat, about 7,000 pounds, in a digester or boiler, to the action of a milk of lime composed of about 2,400 pounds of water and 490 pounds of lime, being about seven per cent. of lime, to the action of superheated steam for about six hours, at a temperature of about 300° Fahrenheit. A quantity of sand is then introduced into the digester. The products, after standing some time in the digester, are drawn off. The soapy product is treated with about 980 pounds of sulphuric acid, to combine with the lime and liberate the fat
807 acids. The digester, when charged, is stated to be about three-fourths full of the mixture, which, when under treatment, is continually stirred by means of an agitator. The process described in the supplementary answer employs but four per cent. of lime, in the form of milk of lime. The materials, fat and milk of lime, are heated by superheated steam for eight to ten hours at a temperature of about 310° Fahrenheit, as stated in the answer. The superheated steam is so introduced as to cause a circulation of the contents of the digester, and the stirrer is dispensed with. The two differ somewhat in the time, temperature, and proportion of material. In the first, seven per cent. of lime is used, at a temperature of about 300° Fahrenheit, for six hours; in the second, four per cent. of lime, at a temperature of 310° Fahrenheit, for eight to ten hours.

Q. 6. Having read, and understanding, as you state, the letters-patent of the complainant, and the description of the processes of the defendants, will you please state whether or not, in your opinion, the processes of the defendants, or either of them, are the same, substantially, in principle and mode of operation, as the process described and claimed in the complainant's patent. And if you are of the opinion that the processes of the defendants are not the same as the complainant's, please give the reason for the opinion you may express, and state what experiments, if any, you may have made, from which your conclusions are drawn.

A. With a view of arriving at a definite opinion as to the processes of the complainant and defendants, comparatively, and wherein they are like or unlike each other, I have, as I have already stated, read carefully the complainant's patent and the description of the defendants' processes. I have also carefully read the testimony of Professors Booth and Rogers, of Mr. N. Ropes, sr., of Prof. Lawrence Smith, and I presume

most of the other testimony in this case. I have also read the communication of M. J. Pelouze to the French Academy, entitled "Upon the Saponification of Neutral Fatty Bodies by the Soaps." I have made experiments to determine the accuracy of the statements contained in the said paper, which will be hereafter detailed. I understand, as before stated, the patent of the complainant to describe and to se-
808 cure to him a mode of treatment of fats by which they are decomposed into fatty acids and glycerine, by the action of heat and water alone in close vessels. I will here remark that there is, in my opinion, a great difference in the mechanical surroundings and conditions forming part of the processes of the complainant and defendants respectively. The process of the complainant requires a very high temperature, the melting-point of tin (about 440° Fahrenheit) being the minimum mentioned in the patent, and 660° F. (the melting-point of nitrate of potassa) the highest. It also requires vessels of very great strength, in order to resist the pressure corresponding to such temperatures, "the working pressure" being stated as not likely to exceed "two thousand pounds to the square inch." The conditions of complainant's process could not possibly be realized in the defendants' apparatus. The complainant's patent speaks of subjecting the mixture of fat and water in the continuous apparatus described therein, at the desired temperature, for ten minutes; the defendants' require as many hours. Again, the requirements of the patent, that "the vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam," and "no steam or air should be allowed to accumulate in the tube, which should be kept entirely full of the mixture," do not exist in defendants' processes, because the vessels employed by them are not full, or nearly so, and steam, the source of the heat used, is constantly present during the continuance of the processes. In my opinion, therefore, the mode of working, in the two processes, is essentially different. Again, it is my understanding of the patent of the complainant that it describes and claims a process in which the decomposition of fats is effected by the sole action of water in the liquid form, highly heated in close vessels. With this understanding of it, it is my belief that defendants' processes are substantially different in a chemical sense, inasmuch as in the defendants' processes no part of the fat is, in my opinion, decomposed by the sole agency of water, but by the combined action of water as a liquid, and as steam, lime, and heat. It is the opinion of Professors Booth and Rogers
809 as set forth in their testimony, as understood by me, that in the defendants' process a portion of the fat is converted into lime-soap by the action of the lime, and the remainder of the fat into free fat acids and solution of glycerine by the action of water. The theory of Prof. Booth is stated in his answers to Questions 6, 9, 10, 15, 16, and 17 of his examination-in-chief; that of Prof. Rogers in his answers to Questions 19, 20, and 21 of his examination-in-chief. It is the opinion of Professors Booth and Rogers, as set forth in their testimony, that the lime employed by the defendants combines with its equivalent of fat acid, forming a neutral lime-soap, which, in the last process of the defendants, amounts to about four tenths, and that the remainder of the fat, six-tenths, is decomposed into free fat acids and glycerine by the chemical action of the water. I do not think that this theory is correct; but believe, on the contrary, that the lime exerts a decomposing power upon the fat beyond its effect to form a neutral lime-soap. In other words, assuming the seven per cent. and four per cent. of lime used by the defendants in their first and second processes, respectively, to be

capable of converting into neutral lime-soap seven-tenths and four-tenths, respectively, of the fat, I do not believe that the power of the lime ceases with the formation of the lime-soap, and that the rest of the fat is decomposed by water; but think, on the contrary, that the lime, as such or as lime-soap, continues its action until the entire mass of fat has been decomposed, so that no part of the fat in the defendants' process is decomposed by the sole agency of water. My opinion, that the lime used by the defendants exerts a decomposing action upon the entire mass of fat until it is all decomposed, is based in part upon the remarkable comparative rapidity of the decomposition when a small quantity of lime is used, as testified to in this case. I refer to the testimony of Mr. N. Ropes, sr.: "The time for cooking depends measurably upon the quantity of lime used in connection with the water. With no lime, a good stock, well crystallized, has been produced in twenty hours; with one-half per cent. of lime it usually takes about six hours, and probably it could be done in a shorter time with from one to two per cent. of lime. But under all circumstances the same pressure must be applied," &c.

(I have read from the testimony of N. Ropes in the original suit of
810 Tilghman vs. Werk.) In this instance, the time of decomposition decreased fourteen-twentieths, while the lime was capable of combining with but one-twentieth of the fat acids present. This fact clearly shows, I think, that the power of the lime does not cease with the formation of the neutral lime-soap. My opinion on this point is also in part based on the experiment of Prof. J. Lawrence Smith, as testified to by him, conducted in the apparatus of the defendants. In this case the fat was treated as it was usually by the defendants, except that no lime was used. The result was that only about one-tenth of the fat was decomposed in the time required for complete decomposition by defendants' process. At the same rate, without lime, it would require from eighty to ninety hours to effect the decomposition by the defendants' process; and with their four per cent. of lime, (in case such lime exerted no influence after it had united with its four-tenths of fat acid,) forty to fifty hours for decomposition of the entire mass to be effected. My opinion is also in part based upon my experiments made, with a view of verifying the statements, "upon the saponification of neutral fatty bodies by the soaps." My experiments were made as follows: Into a small Papin digester, or boiler, I introduced 1,000 grains of olive-oil and 4,375 grains of water. The digester was provided with a stirrer, and the contents stirred from time to time. The mixture was kept at a temperature of 320° to 330° F., as indicated by a thermometer placed in a socket in the head of the boiler and reaching into the liquid; the operation was continued for three hours. On opening the digester the oil was found floating on top of the water. The watery liquid, concentrated by gentle evaporation to about 1,000 grains, showed a specific gravity of 1.0028, the quantity of glycerine being inappreciable to an ordinary hydrometer; there were traces of fat acids. In a second experiment precisely the same quantities of oil and water were, at the same temperature, and for the same time, in the same vessel, but with the addition of forty per cent. of the weight of the oil of neutral lime-soap, corresponding to four per cent. of lime; the saponification was almost complete, a few drops of oil only remaining. The specific gravity of the liquid, concentrated as before, was 1.017, corresponding to seventy-one grains of glycerine in a thousand. The alcoholic solution of fat acids
811 decidedly reddened litmus. In a third experiment the same lime-soap that was used in the second experiment, but purified from fat acids and unchanged oil, was again introduced into the digester, and

the operation repeated precisely as experiment No. 2, except that but 1,823 grams of water were used, and the stirrer was not. On opening the digester the saponification appeared to be complete; no oil could be seen. The results of these experiments confirm completely the statements of Pelouze, and show that, under circumstances where the saponifying power of water alone is practicably inappreciable, neutral lime-soap has the power to determine the saponification, and that the power is not impaired by the operation. I believe that the same quantity of lime-soap is capable of indefinite action. How to explain this action is not in my power. Pelouze supposes that the neutral lime-soap breaks up into an acid-soap and a very basic-soap, the latter acting upon a new quantity of fat, as free alkali would. Without expressing any opinion as to the theory of the subject, the fact is beyond doubt that a neutral lime-soap will effect the decomposition of fat under condition in which the water alone will not. I think, moreover, that it is clear that the same power is exerted by the lime-soap in the defendants' processes, and that in this we have the explanation of the observed fact of the greatly increased rapidity of the decomposition when a small per cent. of lime is used. This action of lime-soap in causing decomposition by its presence is not a singular phenomenon. There are other instances known in chemistry, and they have been grouped under the somewhat vague term of catalytic actions. For example:

1. One pound of sulphuric acid in the continuous ether process is capable of converting tons of alcohol into ether and water, the acid remaining unchanged.

2. Dilute sulphuric acid converts starch into gum, and finally into grape sugar, the acid being unchanged.

3. Strong sulphuric acid will convert pure woody fibre into grape sugar, the acid remaining unchanged.

4. Oxide of cobalt will cause the decomposition of hypochlorite of lime into oxygen and chloride of calcium at a low temperature, the oxide remaining unchanged and being capable of acting indefinitely.

5. Black oxide of manganese will cause the decomposition of
812 chlorite of potassa by heat at a temperature far below that necessary for the decomposition of the pure salt, the manganese remaining unchanged and capable of acting indefinitely.

6. Glycerine, aided by heat, will cause the decomposition of oxalic acid into formic and carbonic acids, the glycerine remaining unchanged and capable of acting indefinitely.

To sum up what I have to say in answer to the question, I state as my opinion—

1. That the complainant's process decomposes fats by water.

2. That I do not regard the decomposition of fats by water and some other chemical agent combined as the same process, chemically considered, as decomposition by water alone.

3. That no part of the decomposition in the defendant's processes is effected by water alone, but that the lime, as such, or as lime-soap, exerts its power to the end of the operation.

4. That, for reasons stated above in reasons two and three, I do not regard the processes of the defendants as being the same, substantially, as that of the complainant, but think that there is a marked difference between the two.

5. That the processes differ widely, in the character of the vessels employed, in time, temperature, and corresponding pressure; the conditions described in complainant's patent being impossible of realization in defendants' digester.

6. The decomposition of fats by water alone, at temperature between 320° and 330°, could not be commercially carried out on account of the long time required for the completion of the operation.

Adjourned to to-morrow, (Friday, August 13th,) at 10½ o'clock a. m.

FRIDAY, *August 13th, 10½ o'clock, a. m.*

Examination of B. Howard Rand resumed.

Present: B. C. Tilghman, esq., for complainant, and Charles B. Collier, esq., for defendants.

813 Cross-examined by B. C. Tilghman, esq.:

X Q. 7. How long have you been engaged in investigating the subject, preparatory to your examination herein?

A. I have no memorandum of the exact time, but think about three months.

X Q. 8. Your answers to the questions in chief were prepared by you in writing previous to your examination, and read by you from such writing, were they not?

A. They were. I made some alterations during the reading, but wish what I gave to the notary to be considered as my testimony.

X Q. 9. What is the chemical nature or constitution of defendants' product, when made with four per cent. of lime, as described in their supplementary answer.

A. It consists of lime-soap, fat acids, and glycerine in solution. About forty per cent. of lime-soap and sixty per cent. of free fat acids would represent the fatty portion of the product, the remainder being glycerine in solution.

X Q. 10. What would be the nature of their product when made with seven per cent. of lime, as described in their original answer?

A. About seventy per cent. of lime-soap and thirty per cent. of free fat acids, constituting the fatty part, the remainder being solution of glycerine.

X Q. 11. Are these results obtained from your analysis, or from other sources, and if so, from what?

A. These results are not obtained from my own analysis, but are calculated from the known fact that lime-soap contains about ten per cent. of lime.

X Q. 12. Have you ever analyzed or made a chemical examination of defendants' product?

A. I have not.

X Q. 13. What would be the chemical nature of the products of De Milly, when made with four per cent. of lime, as described in the paper of Pelouze, or when made with two per cent. of lime, as described in his patent of 1856, No. 2740, now shown you?

A. When made with four per cent. of lime, as described in Pe-
814 louze's paper, the product would be forty per cent. of lime-soap and sixty per cent. of free fat acids, together constituting the fatty portion, the remainder being solution of glycerine. When two per cent. of lime is used, as in De Milly's patent, the product would be twenty per cent. of lime-soap and eighty per cent. of free fat acids, together constituting the fatty part, the remainder being solution of glycerine.

X Q. 14. What would be the chemical nature of the product of N. Ropes, when made with one-half per cent. of lime, as described in his testimony referred to by you?

A. Five per cent. of lime-soap, ninety-five per cent. of free fat acids, together constituting the fatty portion, the remainder being solution of glycerine.

X Q. 15. Referring to the testimony of defendants' witness, Mitchell, Cross-question 86, that the Croton water used by him to decompose fats contained an appreciable quantity of lime, which combined with its equivalent of fat acid to form lime-soap, what would be the nature of the product as obtained by him?

A. Granting the presence of an appreciable quantity of lime in Croton water, there would be formed lime-soap free fat acids, and solution of glycerine

X Q. 16 Are the chemical actions which take place in the processes referred to in Cross-questions 9, 10, 11, 12, 13, 14 and 15, the same, or are they different in their nature; and if different, in what?

(Objected to by counsel for defendants, inasmuch as Cross-question 15 assumes the presence of lime, in Mitchell's process, in an appreciable quantity; whereas the witness (Mitchell) testified as follows: "The quantity of the lime is so small that it makes no perceptible change in the appearance of the Croton water. It is free fat acid in combination with the impurities of the water, whether they be of lime or any other substance." Cross question 88,)

A. They are the same.

X Q. 17. In the first stage of defendants' process, when four per cent. of lime is used, and the fat, water, and lime are mixed and heated up to and not over 212° F., what chemical action takes place and what product is formed?

815 A. The lime unites with an equivalent of fatty acids, forming a lime-soap. Whether all the lime thus combines at 212°, I cannot say.

X Q. 18. Suppose that the heat was continued at 212° F. in an open vessel for eight hours, what would the product consist of?

A. Lime-soap and solution of glycerine, the remaining sixty per cent. of fat being unchanged.

X Q. 19. Is the use of water heated to about 300° or 310° F., under corresponding pressure, essential to the production of the sixty per cent. of free fat acids existing in defendants' product?

A. The use of water in a liquid state, or as steam, is essential.

X Q. 20. Did you ever heat fat with four per cent. (in a state of hydrate) with steam and without liquid water to about 300° or 310° F., and about seventy-five to eighty-five pounds pressure? If so, what what was the product?

A. I never made such an experiment.

X Q. 21. Can you state whether any, and if so, how much; free fat acids would be produced by such treatment? State your authority.

A. I do not know of any such experiment, and therefore cannot state how much, if any, fat acids is produced.

X Q. 22. As you do not know that steam without any liquid water would produce any free fat acid, under the conditions of defendants' process, I again ask you whether the presence of liquid water heated to 300° or 310° F., under corresponding pressure, is not essential to the formation of the free fat acids existing in defendants' product?

A. I cannot say that I do not know that steam without any liquid water will not produce the effect named; for, although I have made no experiment under the conditions named, nor do I know of any, yet I believe, from general chemical considerations, that steam alone would effect the decomposition. Steam is only water in a finely-divided state,

and in the changes taking place in the defendants' apparatus, when both water and steam are present, my opinion is that the steam, rather than the water, is the active agent in conjunction with the lime or lime-soap. It is a well-known fact in chemistry that mechanical division promotes chemical action. Iron, incombustible in mass, will burn
816 readily when in powder. Steam at seventy-five pounds pressure would be increased in bulk over an equal weight of water about 340 times, and thus its combining tendency increased; hence my opinion that in a digester, with steam and liquid water, the water would be more apt to combine in the vaporous than the liquid condition. For this reason I consider that liquid water is not absolutely essential in the defendants' process, as far as chemical action is concerned, although it is present.

X Q. 23. Do you believe that defendants' process could be practically carried on by the use of steam alone without the presence of liquid water heated under pressure?

A. I do not believe it could be practically carried on; but the difficulty is rather mechanical than chemical. The use of water is necessary for the thorough admixture of the lime and fat for facilitating the admixture by circulation during the process, and for holding in solution the glycerine formed.

X Q. 24. How long a time would it require to decompose the fat completely into a mixture of forty per cent. of lime-soap and sixty per cent. of free fat acid, by the use of steam alone, without the presence of any liquid water, at 310° F. and eighty-five pounds pressure?

A. I do not know, never having made the experiment, nor having heard of the experiment, and having no data upon which to found a calculation.

X Q. 25. Are you prepared to testify that a complete conversion of the fat into lime-soap and free fat acids would ever take place under those circumstances?

A. I am prepared to testify to my belief, but not to my positive knowledge, on the subject.

X Q. 26. Are you prepared to testify positively that it is a fact that any formation of free fat acids whatever will take place under those circumstances?

A. I am not prepared to state it positively as a fact, but that I believe that such change would take place.

X Q. 27. Have you ever decomposed fat completely into fat acids and solution of glycerine by the action of liquid water alone at a high temperature and pressure?

A. I have not.

817 X Q. 28. Have you ever decomposed fat completely or partially into fat acids and solution of glycerine by the action of steam, without the presence of liquid water?

A. I have not.

X Q. 29. Have you any authority whatever, either from experiment or from any standard chemical treatise, for the opinion expressed in Cross-answer 22, "That water would be more apt to combine (with fat) in a vaporous than in a liquid condition?"

A. The fact that mechanical division favors chemical combination is universally admitted, and will be found in most authors under the head of "Circumstances favoring chemical affinity." I have verified the fact by experiment many times. It is also generally admitted that steam is finely-divided water, and is so stated in most of the works on physics. Combining these two admissions, I have the authority for my

statement which I have deduced from them. There is no authority that I know of which expressly states that water would be more apt to combine with fat in a vaporous than in a liquid condition, and I have made no experiment to determine the fact.

X Q. 30. What difference would exist in defendants' product if no steam were used, the materials being heated and mixed to the same degree as at present by any other suitable means?

A. If the vessel were entirely full, and no steam allowed to form—a condition which could not be realized in defendants' apparatus, water, lime, and fat being present and intimately mixed by a stirrer—the products would be the same, in my opinion, as at present. I believe, however, that the operation would be slower than when steam is circulating through the mixture. If a steam space were left above the mixture, and the same conditions realized as in the foregoing supposed case, I believe also in this case that the operation would take longer than when the steam is circulating through the mass. I am supposing that in all cases the same temperature is employed.

Adjourned until to-morrow, (Saturday, August 14th,) at 10½ o'clock a. m.

SATURDAY, *August 14th.*

Present: B. C. Tilghman, esq., counsel for complainant; and C. B. Collier, esq., counsel for defendants.

818 Cross-examination of Dr. Rand continued:

X Q. 31. Referring to the reasoning in your Cross-answer 22, ought not steam at atmospheric pressure, and therefore five times as finely divided as steam at seventy-five pounds pressure, to be more active than steam at seventy-five pounds pressure in producing the decomposition, the same temperature and materials being used in both cases?

A. Superheated steam at atmospheric pressure and a temperature of 320° F. should be more active than steam under pressure at the same temperature.

X Q. 32. And this would be the case, however much or little lime was used, and whatever was the temperature employed, would it not?

A. It would.

X Q. 33. And by the same reasoning steam, at atmospheric pressure, on account of its finely-divided state, ought to be more active than liquid water, at the same temperature, in producing the decomposition of fats into fat acids when no lime is used?

A. It would.

X Q. 34. It follows, then, that if defendants or N. Ropes made a mixture of about forty parts lime-soap and sixty of neutral fat, or a mixture of about five parts of lime-soap and ninety-five of neutral fat, respectively, and passed steam, at atmospheric pressure, through the mixtures with the same amount of circulation and heat as they now employ, they would obtain the same products as they now obtain. Is that your opinion?

A. I think that they would.

X Q. 35. And as steam is more active than water at the same temperature in producing the decomposition, they would obtain the same products in rather shorter time than they now employ?

A. In my opinion they would.

X Q. 36. And the same would be the case if steam, at atmospheric

pressure, was substituted for the water at the same temperature in the process of Mr. Mitchell, of New York?

A. Chemically the changes would be the same in all these cases, but practically, as explained in answer to Cross-question 23, water is necessary for the practical working of the processes.

819 X Q. 37. What would be the practical difficulty of passing steam at atmospheric pressure and a temperature of 300° F. to 390° through a mixture of neutral fat and lime-soap heated to the same temperature in a vessel covered, but at atmospheric pressure only?

A. I have explained, in answer to Cross-question 23, what I believe to be the use of the water. The practical difficulties due to its absence would be the want of a thorough admixture of the fat and lime-soap and the absence of liquid to dissolve the glycerine. I presume that these difficulties might be overcome in practice.

X Q. 38. Is lime-soap soluble or insoluble in four times its weight of neutral fat heated to 410° F.?

A. I do not know.

X Q. 39. Is lime-soap soluble in any proportion of neutral fat heated to 310° F.?

A. I am not able to state.

X Q. 40. If it be the fact that lime-soap is soluble to a considerable extent in neutral fat heated to 310° F., would the practical difficulty of "want of thorough admixture," mentioned in your answer to Cross-question 37, have any real existence?

A. I do not think that it would, provided the steam was passed in divided streams through the mixture.

X Q. 41. Calling your attention to Jury Report of Exposition of 1855, put in evidence by defendants, please state whether or not lime-soap is soluble in heated neutral fat.

A. It is soluble.

X Q. 42. Would not the steam, employed as described in Cross-question 37, furnish water for the formation of the glycerine and its solution to a specific gravity corresponding to the temperature employed?

A. If the mixture were cool when the steam was first passed into it, the steam would condense and furnish the water required to a certain extent—that is, until the temperature of the heat rose to 212 F. After that the glycerine would be carried away with the escaping steam, which could be condensed in a separate vessel, yielding solution of glycerine.

X Q. 43. Then both the practical difficulties due to the absence of liquid water, suggested in your answer to Cross-question 37, disappear on further consideration; is that so?

820 A. They do.

X Q. 44. If neutral fat were exposed to the action of liquid water in a close vessel at 612° F., and a corresponding pressure, on the one hand, and to steam at atmospheric pressure, and at the same temperature, on the other hand, the mixture or circulation being the same in both cases, its decomposition into fat acids and glycerine would be effected by the steam in rather shorter time than by the water, would it not?

A. I think it would; but do not speak from experiment at that temperature. My own experiment, at 320° to 331° F., for three hours, where both liquid water and steam were present, with olive-oil, the steam not circulating through the liquid, resulting in a slight, almost inappreciable decomposition; and the fact stated by Scharling that, by

passing superheated steam of the same temperature (320° F.) through fat, he obtained, in two hours, from two pounds of palm-oil, one pound of free fat acids, leads me to think that the decomposition would be more rapid by the steam than by the liquid water at the temperature named in question, (612° F.) But, as I before said, I cannot speak from experiment at the above temperature, to wit, 612 F.

X Q. 45. In your answers to Cross-questions 31 to 37, and to 42, do you mean that the free fat acids produced by the action of steam on neutral fat, at the temperatures named, would be distilled over, or that they would be found in the vessel in which the fat was originally placed?

A. I think that they would be distilled over. I mean carried over with the steam.

X Q. 46. Would the whole or the principal part of the fat acids produced by the action of steam, at 320° F., be distilled or carried over by the escaping steam as fast as it was produced?

A. I think that it would.

X Q. 47. Would the fact that liquid water was present, and a pressure existed in the vessel corresponding to the temperature used, hinder the distillation or carrying over of the fat acids by the steam, provided the steam was supplied and escaped freely at the pressure employed?

A. I do not think that the presence of water under pressure would hinder the distillation under the circumstances named; but do not speak from experience, not having made any experiments in treating fats with superheated steam.

821 X Q. 48. In Scharling's experiments, Exhibit No. 12, is there any evidence or statement that any free fat acid was produced by the steam, except that which was distilled or carried over with the steam?

A. There is not.

X Q. 49. In any of the descriptions of processes where neutral fats were treated by steam (without liquid water) at temperatures from 300° to 650° F., referring particularly to Gwynn and Wilson's patents, Wilson & Payne's patent, Dubrunfaut's patent, Regnault's Chemistry, Payen's Chemistry, and all the other technical and chemical works cited herein, can you find any evidence or statement that any free fat acid was produced by the steam, except that which was distilled or carried over by the steam?

(Objected to by defendants' counsel as being new matter; also, because neither of the exhibits mentioned above, except Payen, are cited by the defendants, and the witness was not examined-in-chief as to that exhibit.)

A. I have examined the following: Gwynn and Wilson's patents; Wilson & Payne's patent; an extract from the patent of Dubrunfaut, marked Exhibit No. 4, Tilghman vs. Mitchell; extract from Pelouze and Fremy, marked Exhibit 19; extract from Regnault, Exhibit No. 20, same suit; and Exhibit No. 8, in this suit, Payen. In none of which do I find any evidence that any free fat acid was produced, except that which was carried over by the steam. In De Milly's patent, however, in which there is introduced a small quantity of milk of lime, which, with the fat, is heated by a jet of steam at a pressure of ten (10) atmospheres, corresponding to a temperature of 358° F., the fat acids are not distilled over. It is my opinion that the small quantity of water in the milk of lime in De Milly's process would, under the influence of the current of steam at the temperature named, be converted into steam, mak-

ing the process of De Milly essentially a steam process. I have not read the rest of the technical works cited herein.

X Q. 50. Do you understand that in De Milly's process that no water is present in a liquid state at the end of the operation?

A. There is water present at the end of the operation in a liquid state. It is expressly so stated in the patent. I had not
822 seen De Milly's patent until it was handed to me to-day by counsel for complainant, and was under the misapprehension that the steam was superheated.

X Q. 51. Had you not previously seen the defendants' exhibit, Jury Report Exposition of 1855, and defendants' exhibit, Pelouze's paper, both of which refer to the presence of a considerable quantity of liquid water in De Milly's process, and attribute the result in part to said water?

A. I had read the exhibits named. They refer to the French process of De Milly. The patent which I examined was the English patent. I examined it as among the technical works cited in this case, as requested in Cross-question 49. As I before said, I misapprehended its language in reading it too hastily along with the other "technical works cited herein."

X Q. 52. It results, then, from all the investigation you have made upon this subject, that you can find no statement or evidence that, when neutral fat at a temperature of from 300° to 650° F., is exposed to a current of steam without the presence of liquid water, any free fat acid is formed which remains in the vessel in which the neutral fat is exposed to the steam; is that so?

A. I can find no statement or evidence of the fact that the fat acids remain in the vessel under the circumstances named. When the vessel cools, the portion contained in the residual steam therein would condense and remain.

X Q. 53. Then, as far as the authority of recorded facts and processes goes, whatever fat acids were formed in defendants' digester by the action of the steam would be carried out of the digester with the escaping current of steam, would it not?

A. Not necessarily. There may be differences, due to temperature and form of apparatus. The presence of lime-soap may have an influence. Scharling is the only one who used a temperature nearly as low as that of the defendants, as far as I recollect, and he especially used a distillatory apparatus. The water present may tend to retain the fat acids, and yet not be the instrument of the chemical changes. I have before given my reasons for supposing that, in the presence of steam and liquid water, the steam would be more likely to be the decomposing agent of the fat than the liquid water.

823 X Q. 54. Have you changed your opinion given in Cross-questions 46 and 47, that the presence of liquid water under pressure would not hinder the distillation of fat acids, produced by the action of steam on fat at 320° F.? and if so, please give your reasons.

A. I especially said in answer to Cross-question 47, that the opinion expressed was not from experience. I cannot say what hinders the distillation of the fat acids in the defendants' digester and that of De Milly. As in both of these processes steam and water are used, it might be a reasonable inference that the water did hinder the distillation of the fats, though in what manner it is not easy to say. We do not know what is going on in the digester; and my opinions on this portion of the subject, I have already said, were inferences, and not the result of actual experiment. Until the experiment is made of acting upon fats with steam alone in a digester, with lime-soap at the tem-

perature used by the defendants, it is impossible for me to say what it is in their process that prevents the distillation of the fat acids.

X Q. 55. What is the explanation of the difference between the results with palm-oil, where fifty per cent. of fat acids were distilled over in two hours, and his experiment with tallow, where the decomposition was so "slow as not to be advantageous for practical use?"

A. It is generally admitted that palm-oil is very easily decomposed.

X Q. 56. If the palm-oil had contained free fat acids when it was subjected to the steam, would not these fat acids have been the first to be distilled?

A. They would.

X Q. 57. If, then, the palm-oil used by Scharling had been of the kind referred to in Roret's Encyclopedia, page 82, (heretofore cited in this case,) containing from one-third to four-fifths of free fat acid, might not the results mentioned by Scharling have been attained without any decomposition of the remaining neutral portion of the palm-oil?

A. Scharling expressly says that he used fresh palm-oil. He also speaks of decomposing castor-oil, whale-oil, dolphin-oil, wax and
824 tallow; hence I cannot think that he could have made such a mistake as to confound the obtaining of free fat acids from rancid oil, with the process of obtaining them by the decomposition of fresh oil.

Adjourned to Tuesday, August 17th, 10½ o'clock, a. m.

TUESDAY, *August 17th*, 1869—10½ *a. m.*

X Q. 58. What are the limits of temperature of complainant's patented process, as you understand it?

A. Between the melting-points of tin and of nitrate of potassa, or from 440° F. to 660° F.

X Q. 59. Then, any decomposition of fats by liquid water into fat acids and glycerine at temperatures outside of these limits would be a different process from complainant's, as you understand it; is that so?

A. Chemically, the action is the same when fats are decomposed into fat acids and glycerine by the action of liquid water, no matter what the temperature, provided it be not high enough to decompose the products. The process may be different, however, on a manufacturing scale, from difference of apparatus or manipulation. Process means mode of proceeding. In making ether by the old method, about equal weights of sulphuric acid and alcohol were distilled. Only the middle portion of the run of the still could be used, to wit, that coming off at a temperature about 300° F., thus causing much waste. In the continuous process, in which we allow a stream of alcohol to pass into the mixture of alcohol and sulphuric acid steadily, so as to maintain the boiling-point of the mixture constant at about 300° F., the whole of the distillate can be used: the materials used are the same in both cases, and so, to a certain extent, the temperature, yet the processes are considered distinct, and always so spoken of. What amount of difference of temperature, apparatus, and manipulation, when the same materials are used at different temperatures, constitutes a legally different process, is a question which belongs more properly to the court than to the chemist.

825 X Q. 60. What are the limits of temperature of complainant's patented process, considering it as a chemical, and not as a legal question?

(Objected to for vagueness, and for the reason that we have nothing to do, in this suit, with the complainant's "patented process," in its abstract chemical nature and apart from its legal bearings.)

A. As a chemical question, inasmuch as the decomposition is chem.

ically the same at whatever temperature effected, provided the product be not injured, I would state that, chemically considered, there are no limits of temperature below the point of decomposition of the products and above that, at which the decomposition can be effected.

X Q. 61. Then if, in operating with fat and liquid water alone, at 320° F., any part of the fat is converted into fat acids and glycerine, the process, chemically considered, is the same as complainant's patented process; is that so?

A. It is.

X Q. 62. From all your information on the subject, is it or is it not true that, by operating on fat, with liquid water at 320° F., a part of the fat is converted into fat acids and glycerine?

A. I believe it to be so, not as a matter of experiment or authority, but of inference.

X Q. 63. Would the presence of lime-soap or of steam hinder or prevent the conversion of that part of the fat into fat acid and glycerine by the action of the liquid water at 320° F.?

A. The lime-soap would not hinder or prevent the action of the liquid water; it would act conjointly with it, and produce a result which the water alone would not. The steam, in my opinion, would only hinder or prevent the action of the water by its greater affinity, taking precedence of the water in its action. I have given my reasons for this belief in answers to Cross-questions 29 and 44.

X Q. 64. What results would be produced by the conjoint action of the lime-soap and water, which the water alone would not produce?

A. A greater rapidity of decomposition at the same temperature.

X Q. 65. Is this the only difference?

826 A. I believe that it is; it enables the operator to use a lower temperature for the decomposition.

X Q. 66. What is the nature of the chemical action which takes place when fat is decomposed into fat acid and glycerine by liquid water alone at a high temperature and pressure?

A. The combination of the elements of water with the elements of fat to form free fat acids and glycerine.

X Q. 67. What change does the presence of lime-soap make in this chemical action?

A. In both cases the elements of water combine with the elements of fat to form free fat acids and glycerine.

X Q. 68. Then, both when liquid water alone is used and when lime-soap is also present, the results produced and the chemical action which takes place are the same, and the only difference is, that the results are produced in a shorter time at the same temperature; is that so?

A. The product is the same in each case; whether the chemical action is the same is doubtful. When water is heated alone with fat, the action is direct; when lime-soap is present it is probably indirect; hence the chemical action is probably different, and I infer that it is different from the difference of time necessary for the completion of the two operations respectively.

X Q. 69. Is this difference of time or rapidity of action your only reason for supposing that the chemical action is probably different in the two cases?

A. No. In any chemical process, where a new substance is introduced and shown to have an effect, it would be a perfectly natural supposition that the chemical action was different in that instance from the case where it was not employed. Our knowledge of the mode of

chemical action is purely theoretical; we are certain as to our materials, methods, and results, but not as to the changes actually taking place during the progress of the operation. These form the theory of chemistry.

X Q. 70. Suppose that the time required for the operation was the same when lime-soap was used, as when water alone was used, at the same temperature, would you then infer that the chemical action was probably different in the two cases?

A. I should suppose that the lime-soap was an inert substance, and therefore that the chemical action was the same.

827 X Q. 71. Then, the shortening of the time of the operation when lime-soap is used is the only fact which induces you to believe that the lime-soap is not an inert substance; is that so?

A. It is.

X Q. 72. Then, the shortening of the time of the operation when lime-soap is used is the only fact which induces you to believe that the chemical action is probably different when lime-soap is used?

A. It is the only fact. It is the effect referred to in my answer to Cross-question 69.

X Q. 73. Suppose that the same fact or effect, to wit, shortening of time of operation, was produced by the addition of any other chemical substance—for example, a quantity of free fat acid—would you then make the same inference, to wit, that the chemical action was different in the two cases?

A. I should; because a new chemical substance had been introduced and shown to have had an effect.

X Q. 74. Suppose that the same fact or effect, to wit, shortening of time of operation, was produced by the addition of any new force or condition—for example, agitation or circulation—would you then make the same inference, to wit, that the chemical action was different in the two cases?

A. Unless the "force or condition" be specified, I cannot answer. In so far as it is specified, to wit, "agitation or circulation," I do not think that the chemical action would be different; because it is a general rule in chemistry, to which, however, there are exceptions, that mechanical means will not cause chemical decomposition. It would aid the process by favoring the contact necessary for combination.

X Q. 75. Suppose a shortening of the time of operation was produced by the addition of an extra quantity of water, would you then make the inference that the chemical action was different?

A. I should not, because no new chemical substance has been introduced.

Adjourned to Wednesday, August 18th—10½ a. m.

828 WEDNESDAY, *August 18th*, 1869—10½ *a. m.*

Met pursuant to adjournment.

X Q. 76. I read from "Storer's Dictionary of Solubilities:" Cambridge, 1864, page 414: "When a neutral oil is dissolved in warm alcohol, and an alcoholic solution of potash added to it, the mixture is instantly saponified on being heated to boiling." (Pelouze Compt. Rend., vol. 40, p. 609, 1855.) It being well known that the saponification of oil by a watery solution of potash requires several hours' boiling, I ask you whether the chemical action of saponification is different in the two cases?

A. I do not think that the chemical action is different. It is ex-

pressly stated in the article referred to that the alcohol (which contains the water necessary for saponification) acts by facilitating contact. In the case of a watery solution of potassa, with oil in a state of mixture, the long time required is due to the fact that only small portions of oil and alkali can come into contact at a time, owing to the insolubility of oil in water. When the oil is dissolved in warm alcohol, and added to an alcoholic solution of potassa, an intimate admixture takes place, and the chemical action goes on rapidly at the boiling-point.

X Q. 77. In this chemical process, then, when a new substance is introduced, (alcohol,) and is shown to have an effect, (shortening the time of operation,) it does not follow that the chemical action is different from the case where the new substance was not used; is that so?

A. It does not follow, because the action of the alcohol is clearly shown to be mechanical, and not chemical; it may be compared to the stirring referred to in answer to Cross-question 74, which acts by facilitating contact.

X Q. 78. Do you consider the dissolving of oil and of potash in alcohol to be a mechanical and not a chemical action?

A. I do. Chemists regard as chemical action that in which two bodies unite to produce a third, which differs in its properties from its constituents, and which, as a rule, cannot be separated into said constituents by other than chemical means. The oil or potash and alcohol are not combined; they are merely mixed. The properties of each can be recognized; they may be separated by mechanical
829 means, as evaporation, and each recognized as unaltered. Solution is treated, in the standard chemical works, as an admixture, not a chemical combination.

X Q. 79. What is the difference between fresh and rancid fats or oils?

A. The rancid fats contain free fat acids, while the fresh do not.

X Q. 80. Suppose that in the old process of saponifying fats by a full equivalent of lime, it was found that when rancid fats were used the saponification took place in much shorter time than when fresh fats were used, would you infer that the chemical action of the saponification of the neutral portion of said fats was different in the two cases?

A. I should not. The shortening of the time could be easily explained. If, by the question, as I suppose, equal weights of neutral and rancid fat are intended to be used, and the saponification of an equal weight of rancid fat takes less time than that of a neutral fat, it is because decomposition is already accomplished, and that really a less amount of neutral fat is to be decomposed in this case than in the other.

X Q. 81. About what proportion of free fat acids do you understand to exist in commercial rancid tallow?

A. I do not know; it would depend on the degree of rancidity.

X Q. 82. The free-fat-acid portion of it would combine immediately with the free lime, and form an equivalent of lime-soap, converting the mass into a mixture of neutral fat and lime-soap, would it not?

A. It would.

X Q. 83. The greater rapidity of the operation would then result from the presence of the lime-soap, mixed or dissolved in the neutral fat, would it not?

A. So far as the neutral fat is concerned, it would.

X Q. 84. Is it not a known fact that the presence of soaps tends to make oils or fats and water mix more intimately with each other?

A. It is, when the soaps are soluble in the water.

X Q. 85. Referring to the fact testified to by Mr. Verdin in this case—Cross-questions 83 to 87—that the slightly acid fats pro-
830 duced by Wilson's steam-tank process saponify in two hours, while neutral fats require four hours, what is your explanation of this greater rapidity of operation?

A. I account for it by the fact that there is less neutral fat present, and by the accelerating action of the lime-soap formed at the beginning of the operation by the combination of the free fat acids present with lime.

X Q. 86. Do you mean to state that a small quantity of neutral fat—say one pound—will be converted into lime-soap in any, and if so, in how much shorter time than 8,000 pounds of neutral fat, the same proportions of lime, water, heat, and mixture being applied in both cases?

A. My experiments in the laboratory in pressure-boiling, compared with manufacturing operations of the same character, have shown me that the operations are more rapid on small than on the large scale, owing, I suppose, to the more rapid transmission of heat through the mass. How much difference in the time required to effect the decomposition there would be between one pound and 8,000 pounds of tallow, treated as stated in the question, I do not know.

X Q. 87. From your chemical knowledge and research on this subject, do you believe that it would require twice or twenty times as long to saponify 8,000 pounds as to saponify one pound of fat, under the conditions of Cross-question 86?

A. I think it would take twice as long, perhaps more; but cannot give a definite answer.

X Q. 88. Do you believe that it would take any perceptibly less time to saponify 6,000 pounds than to saponify 8,000 pounds of fat, under the conditions of Cross-question 86?

A. I think that it would, but cannot say how much.

X Q. 89. On the basis of your answer to Cross-question 87, what would that diminution of time amount to?

A. I do not believe that the diminution of time takes place proportionately to the diminution in the quantity of material, and I do not, in answer to Cross-question 87, fix a definite time. If it be assumed that the time for 8,000 pounds takes just twice that of one pound, and that the reduction of time takes place in that proportion as the quantity of material is reduced, then the diminution of time would be imperceptible by the reduction of quantity from 8,000 to 6,000 pounds.

831 X Q. 90. Did you ever yourself make, or see made by others, a saponification of fat by a full equivalent of time by boiling with water in an open vessel?

A. I think I made the experiment years ago—a laboratory experiment on a small quantity. I do not recollect either the quantity used or the time of operation.

X Q. 91. Were the experiments in pressure-boiling, referred to in your answer to Cross-question 86, made with fat and lime, or were they made with entirely different substances?

A. With the exception of those made in the investigation of this case, they were made on different substances. I did not base my opinion, as set forth in Cross-question 86, especially upon the experiments made with fats in connection with this case.

X Q. 92. Referring to your answer to Cross-question 85, do you believe that the greater rapidity of operation was principally due to the reduction of the quantity of neutral fat present, or to the accelerating action of the lime-soap first formed?

A. It was principally due to the accelerating action of the lime-soap first formed.

Adjourned to Thursday, August 19th—10½ a. m.

THURSDAY, *August 19th*—10½ *a. m.*

X Q. 93. What is the nature of this accelerating action of lime-soap in the case testified to by Mr. Verdin?

A. My answers to Cross-questions 85 and 92 were made under the erroneous idea that the rancid fats alluded to by Mr. Verdin were saponified by less than an equivalent of lime, and under pressure. A more attentive reading of his testimony shows me that more than an equivalent quantity of lime was used, and in an open vessel. I am, therefore, obliged to modify my answers. When more than an equivalent quantity of lime is used, it is impossible, in my opinion, that the lime-soap formed in the first part of the operation by the action of the free fat acids or the lime could have had any effect in hastening the oper-
832 ation. My reasons for this opinion are as follows: When a perfectly neutral fat is saponified by lime, the action is, as in all chemical actions, not instantaneous, but gradual or successive. Hence a portion of lime-soap is formed early in the process, and the quantity gradually increases until the operation is finished. Hence there is lime-soap present in both instances, and I cannot see how it is possible that it should hasten the operation in the one case and not in the other. There is only one theory on which, in my opinion, the more rapid decomposition of the fat spoken of by Mr. Verdin, and rancid fat generally, can be accounted for. It is this: the fat was partly decomposed in Mr. Verdin's case by the action of the steam in Wilson's tank-process; this decomposition would probably pervade the mass, that is, one portion of the neutral fat would not be more acted upon than another. Fat partially decomposed would be, in my opinion, more susceptible to the action of decomposing agents than unchanged fat. I am confirmed in this opinion by the testimony of Professor Booth in this case. In answer to Cross-question 246 he says: "This last depends upon a principle very generally admitted in chemistry, that it is more difficult to commence a decomposition than to continue it, and that, when once begun, it goes on more rapidly."

X Q. 94. What do you understand "rancid fat," or fat "partly decomposed by the action of steam," to consist of?

A. There may be said to be two kinds of rancidity—one due to the oxidation of the impurities of the fat, as stated by Professor Booth in his answer to Cross-question 248 in this cause; the other, to change in the fat itself. I cannot say what would be the product of oxidation in the first case, but think it would be acid. Rancidity due to change in the fat itself yields fat acids and glycerine, which are mixed with the unchanged fat.

X Q. 95. Then, fat "partly decomposed by the action of steam" would consist of a mixture of free fat acids and unchanged or neutral fat; is that so?

A. It is.

X Q. 96. Explain what you mean by the expression, in your answer to Cross-question 93, "This decomposition would probably pervade the mass; that is, one portion of the neutral fat would not be more acted upon than another."

833 A. I mean that the steam would act on the whole mass of the fat, and not on any especial portion of it, so that we should have the same proportion of decomposition throughout the whole.

X Q. 97. What is the product of the "action of the steam" (in Wilson's tank-process referred to by Mr. Verdin in his answers to Cross-questions 83 to 87) "upon the whole mass of the fat, and not on any especial portion of it?"

A. A partial decomposition takes place, yielding free fat acids and glycerine.

X Q. 98. Then you mean that one special portion of the fat—suppose one per cent. of its weight—is decomposed into free fat acids and glycerine by the action of the steam, and the rest of the mass (ninety-nine per cent.) is not acted upon by the steam, and remains unchanged neutral fat; is that your meaning?

A. It is; and I mean, moreover, that each portion of the fat yields its proportion or quota to the supposed one per cent. of decomposed fat. I mean that the change is different from what it would be if the steam acted only on a portion of the fat, say to the depth of six inches from the surface in the tank, long enough to produce the supposed one per cent. of decomposition; and I mean also that the free fat acids and neutral fat would be homogeneously mixed.

X Q. 99. Do you mean that there is nothing else in the "partly decomposed fat" but unchanged neutral fat and free fat acid, homogeneously mixed together, and glycerine?

A. I am not sure that the neutral fat may not have undergone some change of a nature unknown to me, predisposing it to decomposition. That it is more easily decomposed afterwards would show either that it has undergone such change, or that the free fat acids and glycerine present favored decomposition; which supposition is correct could only be decided by experiment. For this reason, I cannot answer positively that there is nothing else present but neutral fat, free fat acids and glycerine. The neutral fat may or may not have been changed, and I could only decide the question by an experiment, which I have not made.

X Q. 100. Are partly-acid fats more quickly saponified by potash and soda than fats entirely neutral?

A. They are.

834 X Q. 101. In this case would the fat-acid portion of said partly-acid fats be immediately saponified by the alkali, and form a corresponding quantity of soluble soap before the neutral portion of said fats would be saponified?

A. It would.

X Q. 102. Would this soap thus formed by the free-fat-acid portion tend to facilitate the formation of a mixture or emulsion of the neutral portion of the fat with the watery solution of the alkali?

A. It would, because potash and soda soaps are soluable in water.

X Q. 103. Would the production of this mixture or emulsion be a probable explanation of the greater rapidity of saponification of the partly-acid fat?

A. It would, because it would tend to maintain the insoluble oil and watery solution of alkali in contact with each other.

X Q. 104. Would the chemical action taking place in the saponification of the neutral portion of said partly-acid fat be different from that which takes place of a fat entirely neutral?

A. I cannot answer positively. When a fat is partly decomposed, there may be changes in the undecomposed portion which may facilitate the chemical action; but we have no positive knowledge on this point.

X Q. 105. Do you know, or can you show, in any chemical or techni-

cal work, any statement that a different chemical process takes place in the two cases mentioned in Cross-question 104?

A. I cannot; it is a matter of inference, the reasons for which inference are contained in my answer to Cross-question 99.

X Q. 106. Is this inference peculiar to yourself, or can you show any authority for it in chemical or technical work?

(Objected to by counsel for defendants, unless it appears that the question involved in it has been considered and is treated of specifically in some chemical or technical work.)

A. The inference is my own. I can cite no authority which states that the processes are different. I do not remember ever having seen the point of the greater rapidity of the decomposition of the neutral portion of rancid fats theoretically discussed.

X Q. 107. If it could be shown that the presence of lime-soap
835 in defendants' product causes an emulsion or mixture of the fat and water to a greater extent than when lime-soap is not present, would that increased mixture or emulsion be a probable explanation of the greater rapidity of decomposition when lime-soap is used?

A. In part it would, but not wholly. The difference of time is too great to be accounted for, in my opinion, by so slight a mechanical difference of condition. In the defendants' digester, when no lime was used, according to Wayne and Smith's experiment, the oil and water were kept in an intimate state of admixture by means of currents of steam passing through them. They would thus form a sort of emulsion, such as can be seen by violently shaking together oil and water in a partly-filled bottle. Hence the pressure of the lime-soap, supposing it to form an emulsion, would not make a very marked difference in the state of affairs.

X Q. 108. Is the production of an emulsion by the currents of steam, in the experiment referred to, a matter of fact and evidence, or is it only an inference or supposition of your own?

A. It is a matter of inference. I know that when oil and water are agitated together they form an opaque emulsion. As the steam constantly agitates and mixes the oil and water, I infer that the same emulsion was formed in said experiment.

X Q. 109. How great a difference in time would be accounted for by the formation of an emulsion by the lime-soap, as referred to in Cross-question 107?

A. I cannot say, having no experiments or data on which to base an opinion. I made my answer upon general principles. I have said, in answer to Cross-question 102, that I believed an emulsion would favor combination in the case of a potash or soda saponification, for the reasons therein stated. How much difference of time the emulsion would cause is a matter to be decided by experiment. I have never made such, nor do I know of any having been made.

Adjourned to Friday, August 20th, 1869—10 a. m.

FRIDAY, *August 20th*, 1869—10 *a. m.*

X Q. 110. You say, in answer to Cross-question 107, "the dif-
836 ference of time is too great to be accounted for, in my opinion, by so slight a mechanical difference of condition." If you do not know how much difference of time would be accounted for by such a mechanical difference of condition as you have just said in Cross-question 109, how can you tell whether such difference of time is greater or less than any given quantity?

A. That the emulsifying of fats facilitates saponification is, I think, generally admitted. To what extent it shortens the time of operation over simple, thorough mechanical admixture, I have already stated that I do not know. That the difference of time would be due to so slight a change of conditions as the hypothetical emulsification by the lime-soap is contrary to my chemical knowledge. I know of no instance where so slight a mechanical difference as that between a temporary admixture and a more permanent one, formed by the introduction of a viscid agent, would make so great a difference in the time of operation as is known to exist in this case. All that I can say is, that the lessening of time by the supposed emulsification by the lime-soap is less than the difference of time observed when it is used or when it is not used, at the same temperature, which, judging from the experiments made by Wayne and Smith, may be estimated at about seventy-two hours.

X Q. 111. If the mechanical mixture is continued during all the operation, what you call the temporary emulsion caused by it would really be a permanent emulsion, would it not?

A. It would.

X Q. 112. Then, the difference between the emulsion caused by the presence of a soap, and that caused by agitation, would be one of degrees of completeness, or intimacy of mixture, would it not?

A. It would. I have made many emulsions and seen them made. When oil and water are simply shaken together, the oil is mechanically divided by the water, and a milky emulsion produced; on standing the oil separates and rises to the surface. By adding a viscid substance, the mixture is rendered more or less permanent, and the viscid substance would, with agitation, more thoroughly divide and intermingle the oil and water.

X Q. 113. Verdin states that rancid fat will saponify in two
837 hours, while neutral fat requires four hours. Morfit, Philadelphia, 1860, page 168, states: "The natural fats are more readily saponifiable by bases or acids in proportion to their amount of free acid thus eliminated," referring to the rancidification of fats. What acknowledged fact can you point out, other than the existence of a portion of free fat acids, and the consequent immediate formation of a corresponding portion of soap, as a substantial difference between the saponication of rancid and of neutral fats?

A. I cannot point out any other acknowledged fact.

X Q. 114. Then the explanation of the saving of one-half the time in Verdin's operation must be sought for in this acknowledged fact, must it not?

A. I think only in part. In my answer to Cross-question 93 I gave my reasons for the more rapid saponification of rancid fats, to wit, the well-known chemical principle that bodies partially decomposed are more easily affected by decomposing agents than bodies in which decomposition has not begun.

X Q. 115. In this case, is the chemical action merely increased in activity and rapidity, or is it different in its nature in the two cases?

A. In the present state of our knowledge, it is impossible to say. The increase of the rapidity of decomposition may be due to the same chemical action taking place more rapidly; but, at the same time, we have no proof that the chemical action is not in some degree altered.

X Q. 116. C. T. Jones testifies in this case—Questions 5, 6, 7, 8, and Cross-question 26, and Question 18, before the master—that, by treating fat by water alone, he obtained good decomposition into fat acids and glycerine in five hours, at a pressure of 300 pounds, (corresponding to

about 422° F.;) and that in operating with water and one-half per cent. of lime, he obtained good decomposition in four to five hours, at a pressure of 250 pounds, (corresponding to about 406° F.) In this last case you have stated the product would be about five per cent. lime-soap and ninety-five per cent. free fat acids. Now, referring exclusively to this ninety-five per cent. of free fat acid, is the increased rapidity of action, one-fifth at most, at a slightly lower temperature (17° F.) in any degree explainable, as in Verdin's operation, by a supposed emulsifying
838 power of the lime-soap first formed, and the well-known chemical principle that a decomposition once begun goes on more rapidly?

A. I think that if the supposed emulsifying power of lime-soap exists that it might exert a slight influence. As to the effect of the incipient decomposition in facilitating the process, inasmuch as a decomposition once begun goes on more rapidly, as a general chemical principle, we must admit its application in this case. That neither will account for the entire difference in rapidity of decomposition in this and other cases referred to in this testimony is clear to my mind. The mechanical effect of an emulsifying agent, as I have already stated in my answer to Cross-question 110, is, in my opinion, in any case slight. I do not think that the fact that a decomposition once begun goes on more rapidly will account for the difference, because in that case the decomposition should be proportionately more rapid towards the end than the beginning of the process, which I am not aware is the case. In the experiment of Prof. Booth, described in answer to Question 36 in this case, he shows that a portion of lard, heated with twice its weight of water to 320° F., was four fifths decomposed in eleven hours; but the fatty product was heated thirteen hours more with fresh water to complete the decomposition.

X Q. 117. Your inference that the decomposition is not more rapid towards the end of the operation is based entirely on the supposition that Prof. Booth found that the thirteen hours additional were necessary for completing the decomposition, after four-fifths of the fat had been decomposed in eleven hours, is it not?

A. It is. I suppose that Prof. Booth, from his general knowledge and experiments on the subject, considered it necessary, or he would not have so prolonged the experiment. I know, from experience, that watching a thermometer closely, in a pressure-boiling experiment, is exceedingly tiresome, and think that no one would prolong an experiment in which such watching is necessary more than he considers sufficient to effect the purpose.

X Q. 118. To ascertain precisely the point of time when the decomposition was completed would require a repeated stopping of the operation, cooling and opening of the vessel, and chemical examination of the product, would it not?

839 A. It would.

X Q. 119. Professor Booth having been asked to "describe his experiments and the results produced in detail," do you suppose that he made such repeated experiments, and then when under oath omitted to describe them and their results?

A. I do not suppose that he did. I did not mean, in mentioning experiments, to suggest that Professor Booth had suppressed any evidence. I said general knowledge and experiments on the subject.

Adjourned to Saturday, August 21st—10½ a. m.

SATURDAY, *August 21st*, 1869—10½ *a. m.*

X Q. 120. Apart from suppositions as to the possible results of experiments not made, and judging from the positive results of all the experiments at about 320° F., with fat and liquid water, and without lime, actually made and testified to herein, to wit: 1. Your own experiment for three hours, in which the decomposition was very slight: 2. Professors Smith and Wayne's experiments for eight hours, in which from eight to thirteen per cent. of the fat was decomposed; and, 3. Professor Booth's experiment for eleven hours, in which eighty per cent. of the fat was decomposed—do you or do you not find that the decomposition was proportionately more rapid towards the end than towards the beginning of the operation?

A. I do not. There is considerable discrepancy in the amount of decomposition, which can only be explained, in my opinion, by the difference in the methods of working. I cannot compare my experiments with Professors Smith and Wayne's in the large digester, because in theirs steam was bubbling through the mass, in mine not, which I conceive makes an important difference, as explained by me in answer to Cross question . Professor Smith's experiments made in tubes I cannot compare to mine, for the size of the vessel, method of heating and agitation will, in my opinion, more or less vary the result. For the
840 same reason I can draw no decided inference from Mr. Wayne's testimony. In Professor Booth's experiment, four-fifths was decomposed in eleven hours, and the remainder kept thirteen hours at the same temperature, in order to effect complete decomposition, which does not show that, in the latter part of the operation, the chemical action was more rapid than in the first part. That it is less rapid is shown by the experience of complainant, which has been very considerable. He states in his letters-patent of 1860: "I have observed, in working this process, that though the action of the water in extracting the glycerine from the fat is rapid at first when the water is fresh and the fat contains all its glycerine, yet, as the decomposition advances and the fat gradually loses, and the water takes up the glycerine, that the decomposition becomes slower and slower, so that to extract the last portion of the glycerine from the fat with a moderate quantity of water requires a considerable time when the lower range of pressures are used." Here we have also the anomaly that an emulsive agent, to wit, glycerine, hinders instead of favoring the decomposition, being an exception to the general rule on this subject.

X Q. 121. Referring to Cross-questions 117–119, do you still infer that the fact of Professor Booth's continuing his operation for thirteen hours, without examining the result at intermediate periods, proves that the decomposition was not completed until the end of the thirteen hours?

A. No. It may have been completed at the end of three hours or less. I cannot understand or explain the length of time allowed by Professor Booth in the second portion of his experiment, to wit, thirteen hours, unless he had good reasons for doing so. I should suppose that, having decomposed four-fifths ($\frac{4}{5}$) of the fat in eleven hours, that he would, in the second stage of the experiment, have cooled the apparatus and examined the product at the end of three or four hours, and that if the change were not complete, he would have closed and heated the apparatus again. I should have done so, as the trouble of cooling and opening the apparatus would be far less than that of watching a delicate thermometer at a high temperature for nine or ten hours.

Adjourned to Monday, August 23d—10½ a. m.

841 MONDAY, *August 23d*—10½ *a. m.*

X Q. 122. Do you find in complainant's patent of 1860 any statement that the decomposition is less rapid towards the end of the operation than at the beginning, when the water used is equally fresh and free from glycerine in both cases; or does it not merely state that water, partly saturated with glycerine, is less rapid than water free from glycerine in finishing the decomposition?

A. I do not find any statement that the decomposition is less rapid towards the end of the operation when the water used is equally fresh at the beginning and at the end of the operation. The patent merely states that water partly saturated with glycerine is less rapid in its action in finishing the operation. In ordinary modes of working, as for instance in the defendants' digester, the water would be more charged with glycerine towards the close than at the beginning of the operation.

X Q. 123. Are not the two facts entirely compatible with each other, to wit, (1) that water free from glycerine is more active and rapid in its decomposing power than water partly saturated with glycerine; and, (2) that the decomposition should proceed more rapidly towards the end of the operation than at the beginning, when water equally free from glycerine is used in both cases?

A. I think that the assumption in the question, that the operation proceeds more rapidly towards the close of the process, is not a fact, as I have no evidence whatever of it; admitting its correctness, however, hypothetically, I cannot see any incompatibility between the two statements of the question.

X Q. 124. In Jones' operation, in which ninety-five per cent. free fat acid and five per cent. lime-soap was formed by the use of water, fat, and one-half per cent. of lime, in four to five hours, at about 405° F., by what chemical action was this ninety-five per cent. free fat acid formed?

A. By the conjoint action of the steam and lime-soap; also, perhaps, of the water in the liquid form. These agents being employed at a high temperature, the heat is an essential force.

X Q. 125. In Jones' operation, in which 100 per cent. of free fat acid was formed by the use of water and fat without lime, in five
842 hours, at about 422° F., by what chemical action was this free fat acid formed?

A. By the action of water in the form of vapor, or perhaps as a liquid, at a temperature of 17° F. above that named in the last answer, and a difference of fifty (50) pounds steam pressure. The effect of an equal increase of temperature, as we go up in the scale, is, in my opinion, greater at the higher than at the lower temperature, relatively. I think, in other words, that the 17° F., between 405° F. and 422° F., would produce a much more marked difference of effect than the 17° F., from 305° F. to 322° F.

X Q. 126. In these operations, is the chemical action of the liquid water the same in its nature, both when lime is used and when it is not used, (being proportionate to the temperature in each case,) or is it different; and if so, how?

A. Admitting the action of the liquid water, hypothetically, I would say as follows: In all cases of spaonification, in which free fat acids and glycerine are produced, there is an assumption of six (6) equivalents of water—three (3) to form the glycerine, and three (3) to form the free fat acids. This is the case whether the free fat acids and glycerine

are obtained by the formation of a soap and its subsequent decomposition by the action of an acid, or whether they are formed by the action of steam, or by that of liquid water, or by the conjoint action of lime and steam, or of lime and steam and liquid water. In none of these cases, then, is the nature of the action of the liquid water different. This is discarding all theoretical considerations, and judging from results.

X Q. 127. It follows, then, that the same quantity of free fat acids, if any, will be formed by the chemical action of the liquid water, whether lime be present or not, at the same temperature and for the same time; is that so?

A. My answer must depend upon the meaning to be attached to the phrase "chemical action," as it refers to liquid water and fats. The chemical action of liquid water in the saponification of fats must, I think, be regarded as two-fold: First, it contributes its elements as material to the formation of fat acids or glycerine, or both, to enable them to exist in the free state; second, it may act as the agent of the de-
843 composing force. 1. If we decompose fats by heat alone, fat acids are liberated, the elements of water being obtained at the expense of the decomposition of part of the fat. 2. If we saponify by means of lime or other base, and then decompose the resulting lime or other soap, the chemical change is effected by the base employed for the formation of the soap, and the acid necessary to decompose the soap—the water not acting as the decomposing agent, but yielding six (6) equivalents of its elements as material to form free fat acids and glycerine. I do not think that this process (2)—the old process of saponification with a full equivalent of base—has ever been claimed as one of decomposition by water. 3. If we decompose fats into fat acids and glycerine by the action of liquid water alone at a high temperature, the water becomes the agent of the force, to wit, heat, which effects the decomposition. At the same time the water yields its elements as material for the formation of free fat acids and glycerine, to the existence of which it is essential. 4. If we decompose fats into free fat acids and glycerine by the combined agency of heat, lime, and liquid water, the water acts, in my opinion, as in the second supposed case (2.) The lime, as such, or as lime-soap, is the active agent—the water acting conjointly, and yielding the six (6) equivalents of water necessary. Experiments, although not made with liquid water alone, show that where liquid water will cause but a trace of decomposition, the addition of lime-soap, under precisely similar conditions, will effect nearly complete decomposition. It might be inferred, then, that the water was inert at this temperature during the decomposition, except so far as to supply the material, to wit, the six (6) equivalents of water to the fat acids and glycerine. Without drawing so broad an inference, I feel certain that the lime is the more active agent, and that the water, as liquid, if steam be absent, acts conjointly. It is a known principle in chemistry, that if we have two agents of different chemical activity acting on a third, the more active one will be first satisfied. I consider that the lime, as lime or as lime-soap, is then the efficient agent, and that the liquid water, supposing steam to be absent, acts conjointly and subordinately. With this explaination, I answer the question in the negative, if the term "chemical action" in it is used to signify
844 that water is the agent in the decomposition. If it be intended to mean that the water supplies the six (6) equivalents necessary to the formation of the free fat acids and glycerine as material, I answer it affimatively.

X Q. 128. In Jones' operation referred to in Cross-question 124, the five per cent. of lime-soap is, in your opinion, the active agent in producing the ninety-five per cent. of free fat acid; is that so?

A. It is the more active agent, but acts I believe conjointly with the steam, and perhaps with the liquid water present.

X. Q. 129. Explain the chemical action by which the said five per cent. of lime-soap is the more active agent in producing said ninety-five per cent. of free fat acid?

A. As I said in my examination-in-chief, (Answer 6,) I do not offer an opinion as to the theory of the mode of action of the lime-soap; my belief that it is the more active agent rests upon experiment. The quantity of lime-soap in Jones' operation referred to, to wit, five (5) per cent., is but one eighth ($\frac{1}{8}$) of that used by me. As the same lime-soap appears capable of indefinite action, the effect of the use of a smaller quantity would only be to prolong the operation.

X Q. 130. Then you cannot explain in any manner satisfactory to yourself, as a chemist, the chemical action by which the said five per cent. of lime-soap is the most active agent in producing said ninety-five per cent. of free fat acid; is that so?

A. I consider the theory of Pelouze as a probable one, but one founded rather on inference or analogy than experiment. I consider it satisfactory to me as a chemist.

X Q. 131. Please explain in detail, in the manner satisfactory to you as a chemist, the chemical action by which said five per cent. of lime-soap is the more active agent in producing said ninety-five per cent. of free fat acid.

A. At the temperature used, (405° F.,) the neutral lime-soap is supposed to be decomposed into an acid lime-soap and a very basic lime-soap—the latter acting as free lime would do to decompose another portion of the fat, reforming neutral lime-soap—glycerine being set free. This action is supposed to continue until all the fat is decomposed. The action is parallel to that supposed to take place in the continuous
845 process for making ether. At the proper temperature, (about 300° F.,) it is supposed that the sulphuric acid and alcohol, which had combined to form sulpho-vinic acid, are split up into free sulphuric acid and ether; that fresh sulpho-vinic acid is again formed by the union of sulphuric acid and alcohol, and again decomposed, so that the process is indefinite.

X Q. 132. I read from Pelouze's paper, Defendants' Exhibit, Compt. Rend.: "In the new reactions, of which we have just spoken, it is understood that water, at a temperature of 150° to 160° C., (302° to 320° F.,) can decompose a neutral soap into an acid soap and a very basic soap, and that this acts secondarily upon a new quantity of the fatty matter, as an alkali in the state of liberty would do." The heated water is then the primary and active agent which decomposes the neutral lime-soap, is it not?

A. According to the statement of Pelouze, it is. I have had no means of verifying his statement as to the formation of an acid and a basic lime-soap, and am not, therefore, prepared to say positively that the water is the active decomposing agent. He probably reasoned from analogy, knowing that the common potash and soda soaps are thus decomposed at common temperatures.

X Q. 133. As the heated water is the primary active agent in decomposing the neutral lime-soap, and the products of this decomposition act "secondarily" in decomposing the neutral fat, it follows, logically, that the heated water is the primary active agent of the decomposition of the neutral fat, does it not?

A. Admitting the correctness of Pelouze's statement, that the water is the primary active agent, and that the products of the decomposition "act secondarily" in decomposing the neutral fat, it does follow, logically, that the water is the primary active agent in decomposing fat; but it is also true that it acts not directly, but indirectly, setting free a basic substance. The direct agent is—assuming the theory to be correct—the basic lime-soap acting as free alkali. Hence, the saponification is to be compared with that of the common soaps when a full equivalent of alkali is used and water is assimilated. Each portion of the fat in succession is supposed to form a neutral lime-soap, the decomposition
of which by heated water is then only a stage in the process. The
846 water can no more be considered as the direct cause of the change
of the neutral fat into free fat acids and glycerine, than in the case of the ordinary soaps, supposed to be subsequently decomposed.

X Q. 134. What is the decomposing agent upon the neutral fat, producing the free fat acid and solution of glycerine, in Mitchell's process, where fat and liquid water, without the addition of lime, are heated to 374° F., at 180 lbs. pressure, in about eight (8) hours?

A. Steam is present above the fat in the upper vessel. As far as the steam comes in contact with the fat, the decomposition is, in my opinion, due to it; otherwise, to liquid water at the temperature named. I said in my answer to Cross-question 16 that, presuming an appreciable quantity of lime to be present in the Croton water, the process was the same, in its nature, to other processes named in said question in which lime was used. I have since examined an analysis of Croton water by Professor Silliman (Appleton's American Encyclopedia, vol. 16, page 271;) it contains six grains and six hundred and sixty thousandths ($6\frac{660}{1000}$) grains of solid matter to the gallon, of which .607 of a grain is sulphate of lime and chloride of calcium. These would not be decomposed. There is also 2.131 grains of carbonate of lime, equal to about one (1) grain of free lime to the gallon of water. Supposing the eight (8) pound gallon to have been used, the quantity would be one (1) grain of lime to fifty-six (56) thousand of water, or $\frac{1}{560}$ of one per cent.—an inappreciable quantity, in a manufacturing point of view, although appreciable to analysis. In another analysis of Silliman's, which I have not been able to see in detail, the quantity of solid matter is greater—$10\frac{93}{100}$ grains to the gallon. Assuming the same proportionate quantity of carbonate of lime in the solid matter, the quantity to the gallon would be about doubled. Hence, I do not regard Mitchell's process as the same as the others named in Cross-question 16, but simply, practically speaking, a process of decomposition by steam and liquid water. As regards the percentage of lime and of lime-soap to the fat present, the per cent. of lime to the fat present is equal to $\frac{13}{1000}$ of one per cent., equal to $\frac{13}{100}$ of one per cent. of lime-soap, taking the figures of the first analysis named as the basis of calculation.

Adjourned to Wednesday, August 25th—10½ a. m.

847 WEDNESDAY, *August 25th*—10½ *a. m.*

X Q. 135. Said analysis of Silliman shows 1.865 grains of carbonate of soda and .662 grains of carbonate of magnesia, which would also form soaps in the same manner as the carbonate of lime, and would about double the total quantity of soap, as stated in your last answer; is that so?

A. It is.

X Q. 136. Taking the second analysis of Silliman referred to, in which

the quantity of solid matter is about double that of the first, the total quantity of soap in the mass would then be about four times that mentioned by you in Cross-answer 134; that is, it would be about one-half of one per cent.; is that so?

A. It would be, assuming the quantity—about eleven grains of solid matter in the second analysis—to be a correct one. It is cited in a report of the watering committee, of Philadelphia, for 1852, without detail and without authority. From the much larger quantity of solid matter present than in the first analysis cited by me, I am of the opinion that there is some mistake.

X Q. 137. Taking the two analyses cited by you, as representing common manufacturing water, it follows that there would ordinarily be from one quarter to one-half per cent. of lime or other soap present with the fat, even when no lime or alkali had been intentionally added; is that so?

A. I do not think that ten grains of solid matter to the gallon represents an ordinary manufacturing water. Assuming it to be so, I answer the question in the affirmative as to the one-half per cent., and even without such assumption as to the one-quarter per cent.

X Q. 138. As the quantity of soap present acts indefinitely, as you have heretofore explained, it follows that, in your opinion, the chemical action which takes place when fat and ordinary manufacturing water, without the intentional addition of lime, are exposed to a high temperature and pressure, is the same in its nature as when lime is intentionally added to the fat and water; is that so?

A. I do not think so. We have no experiment on record, to my knowledge, in which less than five per cent. of lime-soap was
848 intentionally used. This is twenty (20) times as much as the quantity of mixed soap called for by the authentic analysis cited by me. It is very possible that a certain percentage or proportion of lime is necessary for the beginning of the operation, after which it is continuous. Besides, experiments made with ordinary manufacturing water, without the intentional addition of lime, show a difference in the process from that when lime is intentionally added. Until I should have proved positively, by experiment, that one fourth of one per cent. of lime-soap, equal to one-fortieth of one per cent. of lime, or even double these quantities, would make an appreciable difference in a manufacturing sense, either in time, temperature, or product, I must adhere to my answer given to Cross-question 134.

X Q. 139. Then, the increase or diminution of the quantity of soap present changes the nature of the chemical action of said soap; is that so?

A. It does not; but I conceive that the proportion may be so small that there may be no chemical action begun. In all cases of continual action in chemistry, which I can now recall, a certain proportion of the so-called catalytic agent is necessary for the beginning of the action.

X Q. 140. Then, the one quarter or one-half per cent. of soap which is formed by the alkalies, in ordinary manufacturing water, would be decomposed into "acid soap" and "basic soap" by the action of highly-heated water; is that so?

A. I do not know it as a fact; it is a matter of theory. Assuming that an acid lime-soap and a basic lime-soap are formed by the action of highly-heated water, I can see no reason why the one five-hundredth ($\frac{1}{500}$) of one per cent. of the weight of the water should not be decomposed. I answered Cross-question 134 as to practical results and not as to speculations as to the action of practically inappreciable quantities. Nothing

can be more certain than that, on a large scale, chemical changes are different in their nature, when an appreciable quantity of lime is used, and when it is not, even supposing an infinitesimal amount of the same chemical action should take place, which is possible. This is shown by the results of all the experiments known to me on the subject.

849 X Q. 141. State, particularly and in detail, what is the difference in the nature of the chemical changes which take place when fat with one-quarter or one-half per cent. of lime-soap heated together with water to high temperature and pressure (say 300°) to 400° F.) on the one hand, and when fat and five per cent. of lime-soap are heated with water to the same temperature and pressure on the other hand.

A. I have already said that in the one case the quantity of soap formed may be so small as to be inappreciable in effect, as is known to be the case in other continuous or so-called catalytic operations. In this case the difference would be, that in the one case there would be no hastening effect of the lime-soap, and in the other there would be. I cannot specify any other difference, but experiment shows that, when an appreciable quantity of lime is used with "manufacturing water," there is an acceleration of the process. I believe that the water-process is not now practically carried on in this country, except by Mr. Mitchell, even under the complainant's license, as is shown by the testimony of Messrs. Jones and Ropes, without such intentional addition of lime. If the nature of the chemical operation was appreciably the same in both cases—that is, with and without added lime—this would be unnecessary. In the Smith and Wayne experiment, in the defendants' digester, the time required, when steam and "manufacturing water" alone were used, was estimated at ten times that required with the same agents and forty per cent. of lime-soap. If the lime in the "manufacturing water" were acting in the same chemical manner as that in the added lime-soap, this great disrepancy would not, I think, have existed. From the defendants' answers, when the quantity of lime-soap was reduced from seventy to forty per cent., the lengthening of time required was but one fourth; the difference of temperature, however, 10° F. in the latter case, prevents an accurate comparison. The question is one which can only be settled by the simple experiment of working with distilled water and ordinary manufacturing water, other conditions being the same. One such experiment would be worth more than hours of theorizing and conjecture.

850 X Q. 142. Then, Professor Booth's experiment, in which he obtained a decomposition of eighty per cent. of the fat, with water alone, in eleven hours, and a complete decomposition thereof in thirteen hours additional, (or some unknown less time,) at about 320° F., is more reliable than the theoretical estimate of Professors Wayne and Smith, made from the partial result obtained in an incompleted decomposition; is that so?

A. I cannot compare accurately the experiment of Professor Booth with that of Messrs. Smith and Wayne, on account of difference of condition. He used lard; they used tallow. Lard is more easily decomposed than tallow. Supposing the decomposition to have been uniform throughout, the calculation of Messrs. Smith and Wayne—that if one-tenth ($\frac{1}{10}$) of the tallow were decomposed in eight (8) hours, the whole would have required eighty (80) hours—is exact. The operation carried to completion would probably have taken more than eighty hours, inasmuch as the decomposition becomes slower towards the end of the operation, as is shown by the complainant in his letters-patent of 1860, as

follows: "Yet, as the decomposition advances, and the fat gradually loses, and the water takes up the glycerine, that the decomposition becomes slower and slower; so that to extract the last portion of glycerine from the fat, with a moderate quantity of water, requires a considerable time when the lower ranges of pressures are used." From this I infer that the estimate of Messrs. Smith and Wayne, as to the time required with "manufacturing water" alone, based on an experiment made on a manufacturing scale, is too low, rather than too high. And their experiment may be more relied on, as to the prolonged time required when "manufacturing water" alone is used, than any laboratory-experiment made in a small vessel.

Adjourned to Thursday, August 26th—10½ a. m.

THURSDAY, *August 26th*, 1869—10½ *a. m.*

X Q. 143. Referring to Appleton's American Encyclopedia, volume and page quoted by you, please state the quantity of lime and carbonate of magnesia in Thames water as there given, and the proportion of neutral lime-soap (reducing the magnesia to lime by calculation) which would be produced by the use of one gallon of said water with fat, at a high temperature and pressure.

851 A. There is in the Thames water, equivalent to 19.980 grains of carbonate of lime—imperial gallon, ten lbs.—equal to about 200 grains lime-soap. I would here state that Cross-questions 135 to 141 are calculated to convey the impression that the lime-soap is formed in a similar manner, and, at the same time, when free lime is added to fat and water at a high temperature, and when carbonate of lime is found in the water. This is not the case. When free lime is added to a mixture of fat and water above 212° F., the first chemical action is the formation of a lime-soap, which, if in sufficient quantity, begins at once its hastening action. When carbonate of lime is present in the water, no change takes place until fat acids are set free by the action of the steam or liquid water. These, at some stage of the process, decompose the carbonate of lime, and lime-soap is formed. As fats interfere considerably with the action of acids on bases or weak salts, the change might not take place for a considerable time, and the hastening action of the lime-soap thus formed, if there be enough present, would begin much later than in the case where free lime had been added; hence, there is a wide difference of chemical action in the two cases.

X Q. 144. Then, ten pounds of Thames water, heated to a high temperature and pressure, with about one hundred and eighty grains of neutral fat, would convert it into neutral lime-soap?

A. It would.

X Q. 145. This lime-soap, or any less quantity, would, according to the theory of Pelouze, be decomposed into acid lime-soap and basic lime-soap by the action of the highly-heated water, and this basic lime-soap would act secondarily upon a new quantity of fatty matter as a free alkali, would it not?

A. I have already said that I believed that there may be so small a quantity of lime-soap present, that the hastening or catalytic action may not begin. Such is still my belief, founded on chemical facts. If Pelouze's theory be accepted as absolutely true, there can, theoretically, be no quantity of lime-soap so small that it might not be decomposed by the water in the presence of fat; that it would be so, I am not prepared to state. I have stated what I believe to be a fact, and cannot contradict myself upon a theory.

X Q. 146. Cross-question 145 repeated, and the witness is requested to answer directly, yes or no.

852 A. Yes, according to the theory of Pelouze.

X Q. 147. Is it a fact that neutral lime-soap is decomposed into an acid lime-soap and a basic lime soap by water at a high temperature and pressure?

A. I do not know.

X Q. 148. Is it not the fundamental fact or basis of Pelouze's theory?

A. It is.

X Q. 149. Did you ever make the experiment?

A. I have not.

X Q. 150. Why not?

A. First, because I have not been asked to make it; second, because I do not well see how it could be made. Water and lime-soap alone present different chemical conditions from water, fat, and lime-soap; hence, an experiment made without fat would have no value. Moreover, lime-soap might, at a certain temperature, say 320° F., be decomposed into an acid lime-soap and a basic lime-soap; yet, on cooling down for examination, the two might re-unite. Nor can I well see how we could absolutely determine whether a product was an acid lime-soap, or a mixture of free fat acids and neutral soap.

X Q. 151. How many definite compounds of lime and fat acids (taking stearic acid for example) are known and generally recognized by chemists, and described in standard chemical treatises?

A. One—a neutral stearate.

X Q. 152. In your second and third experiments, referred to in answer to Cross-question 6, where fat and forty per cent. of lime-soap and water were heated to 320° F., what was the appearance and consistence of the product when taken from the digester at the end of the operation?

A. In both experiments it was a soft soapy mass, floating on the surface of the glycerine liquor. In the second experiment, a few drops of oil were found floating on the surface of the soap. In the third, none could be seen.

(No re-examination.)

B. HOWARD RAND.

Sworn to and subscribed before me.
[SEAL.]

JOS T. FORD,
Notary Public.

853 (The defendants offer in evidence the caveat of Richard A. Tilghman, filed March 31st, 1854.)

STATE OF PENNSYLVANIA,
City of Philadelphia, ss:

I, Joseph T. Ford, a notary public of the Commonwealth of Pennsylvania, duly commissioned and qualified, residing at the city of Philadelphia, do hereby certify that B. Howard Rand, the witness named in the foregoing deposition, was by me first duly cautioned and solemnly sworn to testify the truth, the whole truth, and nothing but the truth; that so much of his testimony as is contained in the foregoing deposition from question and answer No. one (1) in-chief to No. thirty-one (31) cross-examination, was reduced to writing by me, in the presence of the witness; that, at that stage of the examination, I being unavoidably called away, by agreement of counsel representing the complainant and

the defendants, respectively, the examination was conducted by said counsel in my absence, and so concluded; that the testimony was signed by the witness in my presence, and acknowledged by him to me to be his evidence in said cause.

And I do further certify that, after the conclusion of said evidence, the same was by like agreement of counsel placed in the hands of the printer to be printed; that, after being so printed, the same was returned to me for transmission to the court, and was then by me retained until by me transmitted to the court; that I am not of counsel or attorney for either of the parties to said suit, or in any manner interested therein.

In testimony whereof I have hereunto set my hand and affixed my official seal, at the city of Philadelphia, this twenty-sixth day of August, A. D. 1869.

[SEAL.] JO'S T. FORD, *Notary Public.*

854 *Comptes Rendues Pelouze Hebdomadaires des Séances de l'Academie des sciences * * * Tome quarante et unième, * * Paris, * * 1855. p, 973.*

[Translation.]

Session of Monday, 3d December, 1855., * * *

ORGANIC CHEMISTRY.—Upon the saponification of neutral fatty bodies by the soaps. By M. J. Pelouze.

One of the oldest and of the most skillful manufacturers of candles, M. De Milly, has made known to the jury of the universal exposition a very important modification in the process of saponification of the fatty bodies, and of tallow in particular, by lime. He has ascertained that the proportion of lime necessary for this saponification, and which he had already a long time since reduced from fifteen to eight or nine per hundredths of the weight of the fatty matter, can be still diminished, and descend to only four hundredths, under the sole condition of submitting to an elevated temperature the mixture of lime, of water, and of fatty matter. The operation is performed upon several thousands of kilos [kilogrammes] of tallow at a time, in a metallic boiler, which is maintained, during some hours, at a temperature corresponding to a pressure of five to six atmospheres.

We can understand the economy of an operation which allows of diminishing by one-half the quantity of sulphuric acid necessary for the decomposition of calcareous soap.

855 It has seemed to me interesting to submit to a careful study a saponification executed in presence of so slight a quantity of base, which is only the twenty-fourth part of the fatty matter acidified.

I prepared a soap of lime by double decomposition, by pouring a solution of chloride of calcium into an aqueous solution of commercial soap. The precipitate, well washed, was introduced into a small Papin digester, with about its weight of water and forty per hundredths of olive-oil. The vessel was kept during very nearly three hours in an oil-bath, at a temperature comprised between 155 and 165 degrees.

The water floating above the precipitate contained in the digester was evaporated; it left a syrupy residue, presenting all the properties of glycerine.

The precipitate, put in ebullition with water acidulated by chlorohy-

dric acid, furnished a fatty matter completely acidified; for it was directly and entirely soluble in alcohol and in the alkalies. In a word, the reaction presented all the characteristics of the ordinary decomposition of the neutral fatty bodies by the free alkalies. Apart from the difference in hardness of the new calcareous soap, which was less, one would have said that it had been a saponification by caustic lime.

Another experiment was made directly with Marseilles soap, mixed with its weight of water and a fourth of its weight of olive-oil. The temperature and the mode of proceeding were the same [as before.] The material, after the reaction, had all the properties of an acid soap; it was soluble in cold alcohol, and in an aqueous solution of potash or of soda. The acids separated from it a fatty substance as entirely soluble in the cold in alcohol as in alkaline solutions.

It results from the double experiment which precedes, that the soaps are as tit [apt] as the alkalies themselves to determine the "undoubling" of the fatty bodies into glycerine and into fatty acids; it is understood, therefore, why [how] I could give to the note, which I have the honor to communicate to the academy, the title, at first sight paradoxical, of saponification of neutral fatty bodies by the soaps.

I have besides assured myself that at the temperature of 165° 856 water does not act upon the oils. To "undouble" them, it is necessary that the mixture of fatty matter and of water should attain and preserve, during a very long time, the temperature of 220°, assigned by M. Berthelot to this latter saponification.

In England, where the house of Price furnishes to commerce immense quantities of stearic candles, the saponification is made by the action of the superheated vapor of water at a temperature still higher. The result from this is free fatty acids and glycerine, very nearly pure, from which industry and medicine have already drawn, and will yet, without doubt, draw great advantages.

In the new reactions of which we have just spoken, it is understood that water, at a temperature of 150 to 160 degrees, can decompose a neutral soap into an acid soap and a very basic soap, and that this acts secondarily upon a new quantity of the fatty matter, as an alkali in the state of liberty would.

The observations of M. Chevreul, relating to the action of water upon the soaps, accord with this explanation.

The experiment of M. De Milly, which has served as the starting-point for my work, is explained in an analogous manner.

We may admit that the saponification of tallow, by means of only four hundredths of its weight of lime, presents several distinct phases, [stages,] in which a basic or neutral soap first forms, and finally changes into a soap relatively acid.

The observations of which I have just given [traced] a summary exposition find a quite simple interpretation in the works of M. Chevreul on the fatty bodies.

They cause to be presented new "undoublements" of this class of substances, so numerous and so important.

From the moment that the simple [sole] elements of water intervene in the "undoubling" of the neutral fatty bodies into acids and into glycerine, we should expect to see science and industry multiply and vary the phenomena of saponification.

I have made—it is now some months—reactions of this order more curious still, possibly, than those of which I have just spoken; that is, the spontaneous saponification of all of the fatty bodies, without exception, with, as well as without, the contact of the air, by the simple mechanical division of the seeds in which they are contained.

857 *Exposition Universelle de* 1855.—*Jury report.*

Rapports du Jury mixte international.
Tome 1. Paris * * * MDCCCLVI, (1856.)
P. 486. Stearic candles. * * *
P. 496. Aqueous saponification in a close vessel.

Chemists liken neutral fatty matters to the compound ethers. This hypothesis was put forth for the first time by M. Chevreul, in his "Researches on Fatty Bodies."

As the ethers "undouble" when they are heated to a high temperature in close vessels with water, one was led quite naturally to attempt to effect this undoubling with the neutral fatty bodies. Experience has confirmed this prevision. This is the origin of the new processes of saponification which we are about to set forth in a few words. It was Mr. Richard Albert Tilghman, chemist, of Philadelphia, who was the first who had the idea of applying this reaction on a large scale. In his patent, taken in London the 25th of March, 1854, he thus sets forth his discovery and his manner of operating:

"My invention consists in a new method of obtaining free fat acids and solution of glycerine from animal and vegetable fatty and oily bodies which have glycerine as their base. * * *

"My invention consists in exposing the aforesaid fats and oils to the action of water at a high temperature and pressure, the effect of which is to cause the combination of the water with the elements of the neutral fats, so as to produce at the same time free fat acids and solution of glycerine. Those fats, which, like palm-oil, are highly colored, are also, to some extent, bleached by the process, and the strong-smelling oils are more or less deodorized. The operation is performed in a continuous manner, by pumping an intimate mixture of the fat and water through a very strong metallic vessel heated to the requisite degree. From
858 it the mixture (now changed into free fat acids and solution of glycerine) escapes through a safety-valve so heavily loaded as not to open by the mere pressure of steam. The solution of glycerine settles from the hot fat acids, and may be purified as usual. The fat acids may be used for making soap and candles at once, or bleached by any of the ordinary methods, or may be distilled with hot steam in the usual manner."

In the specification of the patent of the 18th of July, 1854, the author gives two ways of proceeding to the aqueous saponification. One is the method described above; but to which the author has added a detailed description and a drawing of his apparatus. He sets forth the other in the following manner:

"I mix the fatty body upon which I operate with a third or the half of its volume of water, and the mixture can be placed in any suitable vessel in which it can be submitted to the action of heat at a temperature very nearly the same as that of melting lead until the operation is completed; and the vessel should be closed in such a way that the requisite pressure can be applied to prevent the conversion of water into steam."

Visiting the shop [manufactory] of Messrs. Monier, Jaillon & Co., at Villette, near Paris, we have had the opportunity of seeing the trial of the continuous process in its application to palm-oil. We are sorry to say that the fatty matter, on coming out of the apparatus, was not at all deodorized, and, more besides than that, that it gave out a strong odor of acroleine. From the point of view of the quality of the products,

this arrangement of apparatus then by no means realized the end which the author has proposed. Moreover, in our opinion, the chances of deterioration of a system of apparatus of any kind which works constantly at a temperature capable of exerting a pressure of ninety to one hundred atmospheres, are such that it is hardly probable that industry will utilize it, even if the products which it furnished were irreproachable.

Mr. Professor Melsens, to whom the patent of Mr. Tilghman had remained unknown, took out, on his part, on the 7th of December, 1854, a patent for attaining the same end. Mr. Melsens executes the aqueous saponifications by introducing into "autoclave" metallic boilers [digesters] * * * the natural fats, such as melted tallow, beef-tallow,
859 [suet,] oils, butters, with quantities of water which vary from twenty to one hundred per cent. of the weight of the fatty body used. This water can be acidulated by one to ten per cent. of sulphuric acid of the weight of the fat, although water alone will suffice. The apparatus is kept during some hours at a temperature of about 180 to 200 degrees centigrade. In a patent of addition, of the 4th of June, 1855, Mr. Melsens has described a special "autoclave" digester for carrying on this operation. This digester is at work in the shops of Messrs. de Rouxbaix and Ouden Rouen, at Antwerp. The following are the results of an experiment which these manufacturers willingly made at our request: 1,000 kilogrammes of Buenos Ayres tallow, of which the melting-point was 31° 5 centigrade, had added to it fifty per cent. of water. The mixture introduced into the digester was heated for six hours to 180 degrees, (10 atmospheres.) At the end of this time the tallow was completely acidified. The melting-point of the crude fat acids was 40° 5 centigrade. The same tallow, saponified by fifty per cent. of lime for twelve hours and by thirty per cent. of caustic potash, furnished, in each experiment, a fat acid mixture melting also at 40° 5.

The mixture of fatty acids arising from the aqueous saponification is very crystalline, first pressed cold and then hot; and in the same manner in which this operation is performed on the acids produced by calcareous saponification, it has furnished concrete acids whose melting-point is 55° 5 centigrade. We know that this is the degree at which the best fat acids employed in the manufacture of candles melt. The melting-point of the stearic candles exhibited by Mr. De Milly is habitually between 54° and 55°.

The pressed fat acids are very dry to the touch, very hard, of a beautiful transparency, and so white that, transformed into candles, they may be delivered at once for consumption without need of being exposed to solar light.

The facility and the economy which attend the execution of a process which allows us to transform in a single operation the neutral fats into fat acids which can be directly submitted to pressure lead us to hope that, in a near future, aqueous saponification in close vessels and
860 by the apparatus which we have just indicated will advantageously replace calcareous and sulphuric saponification of fats rich in concrete acids.

SAPONIFICATION BY LIME AND WATER AT A HIGH TEMPERATURE.

We have seen above that, in 1834, Messrs. De Milly and Motard had already tried to saponify tallow by lime and water, heating the mixture in a digester up to the temperature of 136° centigrade. The solidification of the calcareous soap, a product which prevented effecting a suit-

able agitation of the mixture, and other reasons which we have already set forth, and to which it is useless to return, caused the employment of this method to be given up. Last year M. De Milly resumed this process, but by changing completely all the conditions of the operation. We are about to describe it just as we have seen it practiced in the month of September in the shops of Mr. De Milly, at Chapelle, near Paris.

Into an isolated cylindrical digester of a capacity of three to four cubic metres there were introduced by the man-hole 1,000 kilogrammes of tallow, forty kilogrammes of lime, previously brought to the condition of milk [of lime,] and three hectolitres of water. After having closed the digester, there was passed into it steam at five atmospheres of pressure. When the temperature of the mixture had arrived at about 140°, a very brisk reaction, with elevation of temperature, set in, and it was necessary to intercept the communication with the [steam] generator to prevent, by reason of the excess of tension produced, the transfer of a part of the mixture into the generator itself. When this brisk reaction had subsided, and when the pressure in the digester was in equilibrium with that in the generator, steam was again caused to enter, and this was continued for eight hours, taking care to stir the mixture continually by means of a mechanical agitator contained in the digester.

On drawing off, at the end of two or three hours of action, a very small quantity of the mixture from the boiler, we are able to prove that all of the calcareous soap which had been formed was dissolved in the non-saponified fatty matter. This solution was limpid and scarcely colored.

861 During the whole time that the operation continued the mixture was maintained at a temperature of 150° to 155°, (four and a half to five and a half atmospheres.) The acidification of the tallow was accomplished in a much shorter space of time, when the temperature was raised to between 165° to 170°.

When the acidification of the tallow is finished, the fatty acids obtained retain the soap of lime, and the whole presents itself under the form of a very feebly colored liquid. Mr. De Milly set the acids free by treating the product with dilute sulphuric acid exactly by the same process as that which we have indicated for the decomposition of the ordinary calcareous soaps. The free fat acids are in every respect comparable with those furnished by the ordinary calcareous saponification. The operation which we have just described presents two very distinct orders of phenomena. The first embraces the saponification of one-third of the fatty matter by the lime, and the formation of neutral soaps of lime which dissolve by the rise of the temperature in the rest of the neutral fatty matter. The second embraces the acidification of this neutral fatty matter by the soap of lime and the water. Such is the interpretation which we have given to this operation, which had found some unbelievers. In the month of January, in this year, Mr. Pelouze has demonstrated by experiment that the soaps have, in fact, the property of acidifying the neutral fatty bodies.

The new process of Mr. De Milly presents incontestibly great advantages over the ordinary process of calcareous saponification; in fact, setting aside [apart from] the manual labor, which is much less, it offers over the latter an economy of seventy-two to seventy-five per cent. on the sulphuric acid used; but, according to our idea, it is less economical than the process of simple aqueous saponification, such as Mr. Melsens has established; for, as we have already said, the fatty acids resulting from the aqueous acidification can be directly submitted to pressure;

and the concrete acids, after a slight washing from sulphuric acid and from albumen, can be directly used in candles. (P. 507.)

(Signed) M. STAS, *Reporter.*
DUMAS,
GRAHAM,
PEROZ,
KUHLMAN,
Members of the Jury.

862 *Caveat of Richard A. Tilghman.—Filed March 31st*, 1854.

To the Commissioner of Patents:

The petition of Richard A. Tilghman, of the city of Philadelphia, State of Pennsylvania, respectfully represents that he has invented certain improvements in treating oily and fatty substances, and that he is now engaged in making experiments for the purpose of perfecting the same, preparatory to his applying for letters-patent therefor. He therefore prays that the subjoined description of his invention may be filed in the confidential archives of the Patent-Office, agreeably to the provisions of the act of Congress in that case made and provided, he having paid twenty dollars into the Treasury of the United States, and otherwise complied with the provisions of said act.

(Signed) R. A. TILGHMAN.

DECEMBER 12TH, 1853.

DESCRIPTION.

The invention consists in subjecting animal and vegetable fatty and oily substances containing glycerine to a high temperature and pressure in close vessels, mixed with different agents, according to the effect desired to be produced upon the fatty matter. Thus, when I wish to convert the neutral fatty substances into fatty acids and glycerine, I pump a mixture of the fat and water, under great pressure, through a series of strong metal tubes, kept at about the heat of melting lead, and provided with a cooling-worm and safety-valve at its outlet. The neutral fatty substance is decomposed by the process, and the fat acid and solution of glycerine which issue through the safety-valve separate by settling. This treatment also produces a bleaching and deodorization of colored and strong-smelling fat.

863 When I wish to combine neutral or acid fatty substances with alkalies, so as to make a soap, I pump a mixture of the fat and solution of caustic or carbonated alkali, under pressure, through a series of heated tubes, as before described. In their passage the materials combine into soap, which escapes from the safety-valve. The heat should be about lead-melting when bleaching or deodorization, and lower when white fats are used. To effect the quick and complete combination of carbonated alkalies with the fats, I prefer to use a heat of 400° F., or over.

When I wish to produce a bleaching or deodorization of neutral fats and oils, without converting them into fat acids, I pass them, under pressure, through a series of pipes, as before described, kept at about the heat of melting lead, taking care that no water is present.

(Signed) R. A. TILGHMAN,
10 *Prune Street, Philadelphia.*

Witnesses:
B. C. TILGHMAN.
STEPHEN F. SIMMONS.

CITY AND COUNTY OF PHILADELPHIA,
State of Pennsylvania, ss:

On this 12th day of December, 1853, before me, the subscriber, one of the aldermen and justices of the peace in and for said city, personally appeared the within-named Richard A. Tilghman, and made solemn oath that he verily believes himself to be the original and first inventor of the mode herein described of treating oily and fatty substances, and that he does not know or believe that the same was ever before known or used, and that he is a citizen of the United States.

(Signed) R. A. TILGHMAN.

Sworn and subscribed this 12th day of December, 1853.

(Signed) STEPHEN F. SIMMONS,
Alderman.

864 *Application and correspondence of R. A. Tilghman.—Patent-Office. Extracts from the file-contents in the matter of the letters-patent granted R. A. Tilghman, dated October 3d*, 1854. *No.* 11766.

PHILADELPHIA, *August 4th*, 1854.

To the Commissioner of Patents:

SIR: I enclose the specification, drawings, and a certificate of deposit of $10, being the application for a patent by Richard A. Tilghman for a process of "treating fatty and oily bodies," a caveat for which, with fee of $20, was received by you 31st March, 1854. I forward this day, per Adams' Express, a box of specimens.

A patent for Great Britain was granted R. A. Tilghman for this invention, dated 9th January, 1854, the specification whereof was enrolled July 8th, 1854. As the United States caveat was filed 31st March, 1854, information is requested whether, under the rules of the Office, the United States patent (if granted) will necessarily be dated back, and how far?

Mr. R. A. Tilghman being absent in Europe, the Office is requested to correspond with,

Yours, respectfully,

(Signed) B. C. TILGHMAN,
10 *Prune Street, Philadelphia.*

From the original specification of R. A. Tilghman, as filed in the Patent-Office.

To all whom it may concern:

Be it known that I, Richard A. Tilghman, of Philadelphia, have
865 invented a new and improved mode of treating fatty and oily bodies, and I hereby declare that the following is a full and exact description thereof:

The first part of my invention consists of a process for producing free fat acids and solution of glycerine from those fatty or oily bodies of animal and vegetable origin which contain glycerine as their base.

For this purpose I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine.

I mix the fatty body to be operated upon with from a third to a half

of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting-point of lead, until the operation is complete.

The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

The process may be performed more rapidly, and also continuously, by causing the mixture of fatty matter and water to pass through a tube or continuous channel, heated to the temperature already mentioned—the requisite pressure for preventing the conversion of the water into steam being applied during the process; and this I believe is the best mode of carrying my invention into effect.

(Following this is a description of the "continuous" or "coil" apparatus.)

* * * * * * * * * * * * *

Although the decomposition of the neutral fats by water takes place with great quickness at the proper heat, yet I prefer that the pump *e* should be worked at such a rate, in proportion to the length or capacity of the heating tubes *d d d*, that the mixture while flowing through them should be maintained at the desired temperature for ten minutes before it passes into the refrigerator or cooling parts *h h* of the apparatus.

The melting-point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results.

But the change of fatty matters into fat acid and glycerine takes
866 place with some materials (such as palm-oil) at or below the melting-point of bismuth, yet the heat has been carried considerably above the melting-point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat and gradually increasing it, the temperature—giving products most suitable to the intended application of the fatty body employed—can easily be determined.

To indicate the temperature of the tubes *d d d*, I have found the successive melting of metals and other substances of different and known degrees of fusibility to be convenient in practice.

* * * * * * * * * * * * *

The series I have used consist of tin, melting at about 440° F.; bismuth, at about 510° F.; lead, at about 612° F.; and nitrate of potash, at about 660° F.

* * * * * * * * * * * * *

The second part of my invention consists in a process for producing soap by acting on the fatty or oily body by a solution of carbonated alkali.

For this purpose I mix the fatty bodies, in a liquid state, with the quantity of carbonated alkali, in solution, which may be necessary to convert it into soap, and then subject the mixture to a high temperature and pressure in like manner as hereinbefore described in practicing my mode of obtaining fatty acids and glycerine.

And for this purpose the apparatus hereinbefore described for producing the fatty acids and glycerine by a continuous process may be used for the production of soap in a similar manner.

The carbonated alkali may be dissolved merely in the quantity of water intended to remain in the soap produced.

* * * * * * * * * * * * *

The degree of heat required is less than that which is necessary to produce free fat acids, and should generally be kept between the melting-points of tin and bismuth (440° F. to 510° F.)

At about 350° F. the neutral fats will form soaps with the alkaline carbonates, but a higher temperature will produce the result more quickly.

* * * * * * * * * * * * * * *

Having now described the nature of my said invention, and the manner of performing the same, I hereby declare that I claim as of my invention—

867 First. The manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure; and,

Secondly. The manufacturing of soap from fatty bodies by the action of a solution of carbonated alkali at a high temperature and pressure.

(Signed) R. A. TILGHMAN.

Witnesses:
JAMES MCCURLY,
JOHN R. WALKER,
Consulate of the U. S., London.

(Endorsement on the foregoing specification.)

This second part of this specification and the second claim are canceled, in order to form the subject-matter of a separate application for letters-patent.

(Signed) R. A. TILGHMAN.
By his attorney, W. M. TILGHMAN.

SEPTEMBER 16TH, 1864.

868 *Agreement as to testimony.*

Circuit court of the United States, southern district of Ohio.

RICHARD A. TILGHMAN *vs.* MICHAEL WERK ET ALS. } In equity.

SAME *vs.* GEORGE SHILLITO. } In equity.

This agreement, entered into on this 5th day of May, 1869, between the parties to the foregoing suits, witnesseth as follows, to wit:

1. All of the testimony and exhibits heretofore taken or that may be hereafter taken, in the first above-entitled cause, and offered in evidence therein, may be read in evidence in the second above-entitled cause, subject only to exceptions as to its competency.

2. The complainant may read in evidence, at the hearing of said suits, the testimony of Joseph Nason and C. T. Jones, taken in the suit of R. A. Tilghman vs. R. G. Mitchell, as contained in complainant's printed record of said suit against Mitchell, on pages 72 to 77, inclusive, and 22 to 36, inclusive, respectively. Also, Complainant's Exhibits one, (1,) two, (2,) three, (3,) and four, (4) "R. E. S.," pages 28 to 32, inclusive, of said printed record of testimony before the master. Also, Defendants' Exhibit A, December 24th, 1868, "R. E. S.," pages 225 to 230, and

865 Defendants' Exhibit B, December 24th, 1868, "R. E. S.," page 231, of said defendants' printed record of testimony before the master, in said suit against R. G. Mitchell—it being admitted that the

communications embraced in said exhibits are the genuine communications of the persons by whom they purport to have been signed respectively.

3. The defendants may offer and read in evidence the testimony of R. A. Tilghman, contained on pages 103 to 106, inclusive, complainant's printed record in said suit against R. G. Mitchell. Also the testimony of J. B. Monier, and accompanying documents, as contained on pages 5 to 76, inclusive, defendants' printed record of testimony before the master, in said suit against R. G. Mitchell. All questions as to the competency of the testimony so proposed to be introduced by the said parties, respectively, being hereby reserved.

4. It is further agreed that the several articles numbered one (1) to twenty-one, (21,) both inclusive, contained in the "book of exhibits," produced by the defendants and marked "Defendants' Book of Exhibits, W'm B. Dayton, examiner," are copies of the original publications as purported, and may be offered and read in evidence at the hearing hereof with the same effect as the original publications would have if produced. The right of each party to produce and read in evidence the context of such of said exhibits as are extracts and full copies of the letters-patent referred to in said "book of exhibits" being hereby reserved. It is further agreed, generally, that the printed copies of the several patents and documents as contained in the printed records of the original suit of R. A. Tilghman vs. M. Werk, and of same against R. G. Mitchell, are true and correct transcripts of the originals of which they purport to be copies, and that the same may be taken and received as originals in making up the testimony in these suits, though nothing is agreed to as to the admissibility of such documents, (originals or copies,) other than as hereinbefore specifically defined.

GEORGE HARDING,
Solicitor for Complainant.
Per B. C. TILGHMAN.
CHARLES B. COLLIER,
Solicitor for Defendants.

870 Circuit court of the United States, southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz. } In equity.

Testimony of William Cornwall, taken on behalf of the defendants in the above cause, before me, N. R. Wilson, a notary public within and for the city of Louisville, in the county of Jefferson, in the State of Kentucky, on the 10th day of July, A. D. 1869. Present, Charles B. Collier, esq., counsel for defendants; and B. C. Tilghman, esq., counsel for complainant.

WILLIAM CORNWALL, being first duly cautioned and solemnly sworn, deposes and says as follows:

Question 1. Please state where you reside and what your occupation is.

Answer. I reside in Louisville, Ky. My occupation, manufacturing star candles, soap, and oils.

Q. 2. Are you a licensee under the letters-patent granted to Richard

A. Tilghman, dated October 3d, 1854, and do you pay him a license fee thereunder?

A. I am such licensee, and pay him a license fee.

Q. 3. How much do you pay him?

A. Twenty cents per hundred pounds for all fat passing through the digester process.

Q. 4. Do you use an apparatus like the coil or continuous apparatus described in said patent?

A. I do not.

Q. 5. How large is your digester?

A. The iron vessel is forty-four inches diameter and thirty feet long, more or less—there may be a few inches more or less—inside of which is a copper vessel, with space of about six and one-half inches all
871 around between it and the iron, and about four inches shorter than the iron vessel. The copper vessel is covered with copper lid, in which is a man-hole. The lid fits loosely on top.

(The witness, at request of counsel, now produces diagram of the digester as used by him, which is hereto annexed, marked "Exhibit 1, Cornwall, N. R. Wilson, notary public.")

Q. 6. How much fat do you treat at each operation?

A. We average about 7,000 pounds.

Q. 7. How much water do you put in when you first put in the charge of fat?

A. We don't put any water in until the digester stands at a pressure of 240 pounds; any water before this time is accidental, from condensed steam and the milk of lime. When the digester stands—say for five minutes—at 240 pounds, we then put in, as near as we can, water equal to one-half the volume of fat.

Q. 8. When you have put in the fat and the quantity of water as stated, is the digester full of the materials? If not, how many inches does it lack of being full?

A. The digester is not full when we have put in the fat and water as stated; the copper vessel which contains the fat and water lacks about five feet of being full.

Q. 9. In the letters-patent of the complainant it is stated as follows: "The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam." Is that the condition of your digester in your process?

A. Yes, sir. It is closed with exception of the escape-hole, marked E, and the inlet K; and when the boilers are being pumped up with comparatively cold water, the pressure of the boilers will sink from 240 to as low sometimes as 150 pounds, and during that time the digester, which was at 240 pounds, will cool down thirty or forty pounds. The reduction of this pressure causes a boiling in the digester, and escape of steam consequent, which escapes over the top of the copper vessel, between the top and lid, down the sides of the iron vessel, and through the escape-pipe E, which is kept open so as to discharge the condensed water freely, but not so as to waste steam. Both steam and water come out of it.

872 Q. 10. What do you do with the steam and water that come out of escape-pipe E?

A. We catch it all and skim the fat from it.

Q. 11. How do you heat the digester?

A. The digester is heated by steam entering under a pressure at K, entering and filling up the annular space between the copper and iron vessels.

Q. 12. In answer to Question 7 you say that "When the digester stands, say for five minutes, at 240 pounds, we then put in, as near as we can, water equal to one-half the volume of fat." Do you put any more water in during the operation?

A. We do. We change the water and put in another charge of equal quantity after a space of three to five hours.

Q. 13. Why do you do this?

A. Because the first charge only takes two-thirds of the glycerine, and the second charge takes most of the remainder, but not all of it.

Q. 14. How would it operate if you did not put in the second charge of water?

A. Some raw fat would still exist with its glycerine in it.

Q. 15. Do you use lime?

A. We use one per cent. of lime.

Q. 16. What do you use it for?

A. It hastens the operation. The process is more perfect. The fat has less of the raw smell, and I think it harder; also, I think it safer and less injurious to the copper vessel, and less probability of leaks at the seams, if we use a little lime.

Q. 17. I understand you to say that when the fat and water are placed in the copper vessel it (the vessel) is not full by five feet. Am I correct?

A. Yes, within two or three inches. It will not vary but a few inches from five feet.

Q. 18. Is not steam in large quantity continually present in your digester during the operation?

A. Yes, sir. Steam from the boilers is supplied through a two-inch pipe during the entire operation, except when, in pumping up the boilers, the pressure in the boilers is less than in the digester, which is about a half hour. During this interval, when steam is not flowing from the boiler to the digester, the pressure within the digester is gradually falling, and the steam is, in consequence, discharged by ebullition from the water in the copper vessel of the digester, and steam is also cut off during the time of first blowing off the glycerine-water.

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Q. 19. Do you, at any time during the operation, heat the fat to the melting-point of lead (612° F.?)

A. No, sir; we heat to the temperature due to a pressure of 240 to 250 pounds of steam, which is about 400° F.

Q. 20. How long a time does your operation take?

A. Seven to nine hours to do it well, but we have done it in less time—in six hours sometimes. We could work faster by using more pressure—so I was told, but don't know it.

Q. 21. Could your digester stand the "working pressure" stated in the complainant's patent, to wit, 2,000 pounds to the square inch?

A. It was proved to 400 pounds hydraulic pressure when new, and not intended to work over 250 pounds. We prove it annually by water-pressure at 350 pounds.

Q. 22. Under whose directions, if under any one's, do you use lime?

A. Mr. Tilghman told me it would hasten the operation, and would be rather better than if no lime was used; but that the operation could be made without lime.

Q. 23. What do you do with your product to get lime out of it?

A. We boil it with acid water.

Q. 24. How long would it take in your digester to decompose the fat

under pressure of 240 to 250 pounds without the use of lime, and what kind of product would you get?

A. I don't know how long. In experiments we have tried, we have allowed about one-fourth longer time, but were not satisfied with the results as well as when lime was used.

Q. 25. How long would it take without the use of lime, and with only one charge of water equal to one-half the quantity of fat employed?

A. I have no knowledge about our digester. I never tried it with one charge of water.

Q. 26. I understand you, then, to say that you use lime for the purpose of facilitating the operation; am I correct?

874 A. For facilitating the operation and improving the product.

Q. 27. From your experience with your apparatus, will you state whether the process, as practiced by you, would be practicable or profitable without the employment of lime?

A. I have never worked it through and taken accurate notes of the results. I have made some six or eight trials, as stated above, without lime, and had not time to carry it through separately in the process as far as the making of candles, and gave it up because I thought the other was better.

Q. 28. Is the pump used by you, and marked B in your exhibit, necessary in your process?

A. Yes, sir; the use of the pump consists in passing water through the fat.

Q. 29. Do you find any description of a pump in the letters-patent of the complainant for the purpose as used by you?

A. No, sir; I do not.

Q. 30. I understand you to state that the upper vessel or digester, (inside of the iron vessel,) has a loose cover upon it, which is not fastened during the operation, and that there is a space of some inches (three or four) between the cover of the copper vessel and the top of the iron one surrounding it; am I correct?

A. Yes, sir; the cover having a loose man-hole, with a lid in it.

Cross-examined by B. C. Tilghman, esq., counsel for complainant.

X Q. 31. Have you found the decomposing action of the water on the fat, in producing fat acids and glycerine, to become less powerful and rapid as the heat and pressure were diminished?

A. I settled that question, not by experiment, but by reference to table of temperature. I never tried experiments at low pressures; always tried to work as near 250 pounds, without blowing off, as possible.

X Q. 32. When you worked without lime, were fat acids and solution of glycerine produced?

A. Yes, there were fat acids, but not, I thought, so good a quality. Glycerine was also produced.

875 X Q. 33. Was the inferior quality of the fat acids due to an unfinished state of decomposition of part of the neutral fat used?

A. I attributed it to the want of lime, because there was a rawer smell. I thought there was a better decomposition with the lime than without it.

X Q. 34. Did you ever see fats decomposed by water at a high temperature and pressure without lime? If so, describe the time, pressure, quantity of water, and results.

A. I have stated the results of my own experiments. At Mitchell's, in New York, they showed me samples of acids from his process (which were said to be by his process.) I don't know whether they were or not. I saw a boiler in operation which they said was at a pressure of eleven atmospheres. I saw a gauge marked, but I don't recollect the mark. I don't know the time or quantity of water. The sample shown me was good.

X Q. 35. In your apparatus, is the pump used to produce an intimate mixture of the water and fat at a high temperature and pressure?

A. Yes; at as near 250 pounds as we can reach without blowing off steam from the generators.

X Q. 36. In your operations, as described, is the use of water, at a high temperature and pressure, the essential feature?

A. You might say it is one of the features—lime and steam. They are all indispensable to a good result, I consider. If it hadn't been so, I wouldn't have used the lime. That was my judgment.

X Q. 37. Have you ever continued the process without using the lime long enough to ascertain when the decomposition of the fat would be completed?

A. I never continued the operation with a view of ascertaining, scientifically, if the decomposition was complete, but with a view of ascertaining the best product as to hardness and freedom from smell.

WM CORNWALL.
N. R. WILSON,
Notary Public, Jefferson County, Ky.

876 United States circuit court, southern district of Ohio.

RICHARD A. TILGHMAN
vs.
MICHAEL WERK, THOMAS KIRBY, JOHN KIRBY, and M. Schwartz. } In equity.

Evidence offered and testimony taken on behalf of the defendants in the above-entitled cause, before me, William B. Dayton, a notary public and special examiner, at the office of Charles B. Collier, esq., No. 713 Sansom street, in the city of Philadelphia—such testimony having been commenced on Friday, the 4th day of June, A. D. 1869, and continued by adjournment as hereinafter noted.

FRIDAY, *June 4th*—10 *a. m.*

Present: B. C. Tilghman, esq., on behalf of complainant; Charles B. Collier, esq., for defendants.

CHARLES H. GRANT, being produced as a witness on behalf of the defendants, and being by me first duly and solemnly sworn, deposes and says:

Question 1. Where do you reside, and in what business are you engaged?

Answer. I reside in Philadelphia; am engaged in the adamantine candle business.

Q. 2. For how long have you been engaged in such business?

A. About nineteen years and a half.

Q. 3. By what process do you now decompose fats and produce free fat acids?

A. By the sulphuric acid process.

Q. 4. About what percentage of sulphuric acid do you use to decompose fats, and is it concentrated sulphuric acid?

A. We use about seven per cent. of concentrated acid.

877 Q. 5. Have you read, and do you understand, the letters-patent issued to the complainant herein, dated October 3d, A. D. 1854?

A. I have read the letters-patent. I do not recollect the date of them, nor have I read them recently. I believe I understand them.

Q. 6. As a manufacturer of fat acids, will you state—referring to said letters-patent—the lowest degree of temperature designated in said patent for the decomposition of fatty bodies into fat acids and glycerine by the action of highly-heated water, according to your understanding of such patent?

A. It mentions here the lowest degree as being "at or below the melting-point of bismuth."

Q. 7. During the period in which you have been engaged in the manufacture of candles, have you used any other process than the sulphuric-acid process for the decomposition of fats? If so, will you please describe such other process?

A. We originally used the lime-saponification process, making a lime-soap by boiling fats with twelve to fourteen per cent. of lime in open tubs, and then decomposing it (the lime-soap) by sulphuric acid—two and a quarter to two and a half times as much as the lime used. We also used another process, effecting the decomposition by water at high heat and pressure in a close copper tank, mainly with the addition of a half per cent. of lime, sometimes without the addition of any lime, and sometimes with more than a half per cent. We worked under a pressure of about 165 to 170 pounds per square inch, corresponding to a temperature of about 374° F. The tank was a cylinder of copper, bulged out at each end, about three feet in diameter, and ten or twelve feet long. We used twice as much fat as water. The heat was derived from high-pressure steam and fire underneath the cylinder. The cylinder was nearly full, say within about six inches of the top when the heat was well up.

Q. 8. Will you state the result of such process in the decomposition of fats, as practiced by you, both with and without the use of lime, and state whether or not the decomposition was facilitated when lime was used?

A. The result was a decomposition of the fat into fat acids and glycerine, which was facilitated by the use of lime. It was
878 very much hastened, and I believe the decomposition was more perfect when lime was used.

Q. 9. For how long did you use such process?

A. From the time we commenced until we finally abandoned it, I think, was about two years. There was quite an interval between the time we stopped using it regularly and the time that we made some final decompositions with it.

Q. 10. Why did you abandon it?

A. Because we couldn't make satisfactory candles, or make them as cheaply as by the sulphuric-acid process.

Q. 11. By what name was the process which you practiced during the two years referred to known?

A. The water process.

Q. 12. Under whose superintendence and direction was it introduced into your factory?

A. Under Mr. Richard A. Tilghman's.

Q. 13. Did you pay him a license-fee for the use of it?

A. We did; a fee of one-fifth of a cent per pound of fat worked.

Q. 14. Did you at any time manufacture candles from the product of that process alone?

A. We might have made a few candles, but we never made a day's moulding of them.

Q. 15. What did you do with the product of such process prior to its being made into candles?

A. We mixed it, before pressing, with stock that had been distilled, and by this process we made most of the candles during the period we had the water process in use: but we distilled, for a time, the whole product of the water decompositions.

Q. 16. Have you visited manufactories working under alleged licenses from the complainant, and are you familiar with their mode of operating; and can you state whether any of them decompose fats by the sole power of the decomposing agent named in complainant's patent, to wit, water at high temperature and pressure?

A. I have visited a number of such factories. I am not familiar with their mode of operating, and cannot state, of my own knowledge, whether any of them decompose with water alone without the
879 use of lime. I believe they generally use a half per cent. of lime. They all use steam, and steam without external fire.

Q. 17. Do you know whether or not either of them employs the degree of temperature stated in the patent, to wit, "the melting-point of bismuth," (510° F.?)

A. No; I do not know.

Q. 18. Have you read, and do you understand, the descriptions of the defendants' processes, as contained in their answers herein?

A. I have read them, and I believe I understand them.

Q. 19. Will you state whether or not, in your opinion as a manufacturer, the said processes, or either of them, are substantially the same in principle and operation as the process described and claimed in the letters-patent of the complainant?

A. I believe they would make a more thorough decomposition, and make it much more rapidly. The second process of the defendants I believe to be not essentially different from the first, but merely a new device for the circulation of the water and fat. I believe there is an essential difference between the processes.

Q. 20. Have you at any time witnessed an experiment made with a view of testing the practicability of the process of the complainant in the coil-apparatus described in the complainant's patent? If so, state when and where you saw such experiment, by whom it was conducted, and the result thereof.

A. When I was in Cincinnati, in the spring of 1867, I saw apparatus similar to the coil-apparatus described in complainant's patent at work at George Shillito's factory, under the superintendence of R. G. Mitchell and Florence Verdin. The coil was placed in a furnace; the fat and water were placed in a tin vessel, in about equal parts, and pumped through the coil; on the end of the coil was a high-pressure valve. The pumping was done steadily. When the pressure was sufficient to lift the valve, the fat came out into a vessel placed to receive it. The fat did not come out in a steady stream, but in sudden spirts, sometimes making noise enough to alarm those present who were most timid. The decomposition was very imperfect and the smell offensive. That material was wholly unfit for the manufacture of candles.

Q. 21. As the result of your observation of such experiment, what is your opinion as to the practicability of said process?

880 A. I believe it could never be made to work practically.

Q. 22. Upon the hypothesis that the complainant's patent contemplates the use of water alone, under a minimum temperature of 440° F., (the melting-point of tin,) corresponding to a pressure of upwards of three hundred pounds to the square inch, whatever may be the form of apparatus employed, will you state whether or not, in your opinion as a manufacturer, such process is a practicable one?

A. Yes; I do believe it would be practicable if performed in the apparatus of Wright & Fouché.

Q. 23. Do you know of any other form of apparatus than that of Wright & Fouché, in which the decomposition could be effected by the agency of highly-heated water alone, in a useful and practicable manner?

A. I do not know of any.

Q. 24. In the complainant's patent he says: "I deem it prudent to test the strength of the apparatus by a pressure of ten thousand pounds to the square inch before taking it into use; but I believe that the working-pressure necessary in using the heat I have mentioned will not be found to exceed two thousand pounds to the square inch." What do you say as to the utility and practicability of any manufacturing process requiring such heat and pressure?

A. I believe it would be useless and impracticable.

Q. 25. Have you read, and do you understand, Defendants' Exhibit No. 1, entitled "Change of fat in Perkins' engine by water, heat, and pressure?" If you have read it, what inference, if any, as a manufacturer of fat acids, do you derive from it, and would you, at any time prior to the date of complainant's patent, have derived from it, as to the effect of highly-heated water upon fats?

A. I have read it, and do not perfectly understand it, because of the peculiar description of the fats after coming out of the engine. I believe they were decomposed, or partially decomposed, and that their peculiarities arose from mixture with impurities, and the different manner in which they were cooled. It seems to me to suggest the idea of a decomposition of neutral fats into fat acids and glycerine, by water, at high heat and pressure; but I cannot say that it would have
881 suggested it, or that I would have seen the connection, had I not known of the water-decomposition process through Mr. Tilghman, and from other sources.

Q. 26. State whether or not, if you know, there were any manufacturers of fatty acids and glycerine in Philadelphia, or Pennsylvania, during the years 1867–1868.

A. There were none. I manufactured fat acids, but not glycerine.

Q. 27. State, if you know, what adverse interest, if any, there was to the extension of complainant's patent in the State of Pennsylvania, or in the city of Philadelphia, at the time of his application for such extension, to wit, in the spring, summer, and fall of A. D. 1867.

A. There were none that I know of.

Q. 28. What interest, if any, did you, or the firm with which you are connected, have at such time relative to said patent; was it adverse to its extension, or otherwise?

A. It was not adverse. We did not interest ourselves either way, though our interest would have been to have it successful.

Q. 29. What knowledge have you, if any, of a newspaper published in the city of Philadelphia, called the Universe?

A. I know there was such a paper; it was a Catholic newspaper, which I never read.

Q. 30. Are you a member of the Commercial Exchange of this city? If yea, have you ever seen said paper upon the files of said Exchange?

A. I am. I have never seen it there.

Examination adjourned to Monday, June 7th, at 3 o'clock p. m.

MONDAY, *June 7th*—3 *p. m.*

Present: B. C. Tilghman, esq., for complainant; Charles B. Collier, esq., for defendants.

CHARLES H. GRANT, being produced for cross-examination, deposes and says:

X Q. 31. In your experience as a manufacturer of fat acids by various processes, did you ever see any free fat acids that were not fusible at the heat of boiling water?

882 A. No.

X Q. 32. Did you ever see any free fat acids which were not soluble in ether?

A. I do not know anything as to their solubility in ether.

X Q. 33. If you had a fatty body which melted at 85° F., and it had afterwards been submitted to a treatment under conditions not precisely known to you, and you found that that fatty body had been changed so as not to melt at the heat of boiling water, would you not infer, as a manufacturer, that that changed fatty body could not be free fat acid?

A. No; I would infer that it might be either a neutral fat or free fat acid, with a mixture of dirt or mineral substance.

X Q. 34. Suppose that you had purified the changed fat from dirt and mechanical impurities by dissolving it in hot alcohol and letting the clear solution cool, and you then found that the fatty substance precipitated by cooling—would not melt in boiling water, would you infer that it was, or that it was not, free fat acid?

A. I am unable to answer that question, because I have never made an experiment with fat acids and alcohol.

X Q. 35. When did you first learn that fats could be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

A. Shortly after Mr. Richard A. Tilghman took out his patent—I can't fix the date—and from that patent.

X Q. 36. Can you name any book, published prior to 1854, in which it is distinctly stated that fats can be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

A. No, I cannot.

X Q. 37. During the period of your working with the sulphuric acid process, have you always used precisely the same temperature and proportion of acid, or have you varied?

A. No; we have varied both as to temperature and acid.

X Q. 38. Did you not, during a considerable period, heat palm-oil and other commercial fats up to about 340° or 350° F., by driving superheated steam through it for several hours, and when it had attained about that temperature, did you not add about five or six per cent. of sulphuric acid, in order to effect the acidification of the oil?

883 A. Yes.

X Q. 39. As far as your experience goes, did this superheated steam, so driven through the fat at temperatures up to 340° or 350° F., have of itself the effect of converting the mass of neutral fat into free fat acids?

A. No.

X Q. 40. About what was the heat of the superheated steam thus used by you?

A. My impression is about 800° to 1,000° F.

X Q. 41. In a manufacturing sense, was not the fat, after having been thus subjected to the action of this superheated steam for several hours, neutral fat, and not free fat acids?

A. I believe it was neutral fat.

X Q. 42. Did you not apply this process, during a year or more, and upon quantities of six to eight thousand pounds of fat in a charge, and upon more than a million pounds of fat altogether?

A. We applied it to more than a million pounds, and in charges of eight thousand pounds and over.

X Q. 43. Then, from your experience as a manufacturer, you say that passing superheated steam through neutral fat, at temperatures of 340° to 350° F., does not convert that fat into free fat acids; is that so?

A. I am not prepared to say whether it does or does not, further than I have already stated.

X Q. 44. In distilling fat acids, does not the substance distilled pass in the state of vapor from the still over into the condenser?

A. It does.

X Q. 45. If any of the fatty substance in the still passes over mechanically and in a liquid state into the condenser, is not the distillation spoiled to that extent?

(Question objected to for vagueness.)

A. It is, if for no other reason than because it is so dark and dirty as to be only fit to be thrown back.

X Q. 46. Referring to your answers to Questions 7 and 8, as to your use of the water process with one-half per cent. of lime, did not that lime combine in the tank or digester with part of the fat and form a lime-soap?

A. I do not know whether it did or not.

884 X Q. 47. Did you use any means to remove that lime from the fat after it came out of the digester?

A. Yes; we boiled it with sulphuric acid, which caused the lime to precipitate as sulphate of lime, but even with that there was a considerable percentage of fat acid, which was separated by stirring up the sulphate of lime and water when cold.

X Q. 48. In thus boiling it with sulphuric acid to take out the lime, you treated it as if it contained lime-soap equivalent to the quantity of lime used, did you not?

A. Yes; we treated it as we would have done lime-soap.

X Q. 49. What was the rest of the fat which was not combined with the lime as it came from the digester?

A. Mainly fat acids.

X Q. 50. If you had used more lime, say four to six per cent. of the fat, would not the product as it came from the digester have contained a proportionately larger quantity of lime-soap and less free fat acids?

A. Yes; It would have contained less free fat acid and more of the admixture of lime and fat acids.

X Q. 51. Did you ever see any other experiment with a coil-apparatus, than that described in your twenty answers, as having been made in Cincinnati in the spring of 1867?

A. No.

X Q. 52. In that experiment, do you know, of your own knowledge, how long the mixture of fat and water took in passing through the coil?

A. No; I do not recollect.

X Q. 53. Can you then testify that the direction of the patent, "that the mixture while flowing through the tubes should be maintained at the desired temperature (melting lead) for ten minutes before it passes into the refrigerator," was accurately complied with?

A. I cannot state positively; my impression is, that it was as nearly as could be.

X Q. 54. From whom did you get this "impression?"

A. From myself; from my own recollection of it. To my mind, the parties present seemed to do their best to make it succeed.

X Q. 55. Then, I understand that you do not know, of your
885 own knowledge, how long the mixture of fat and water took in passing through the coil; is that so?

A. I don't recollect having timed it with a watch, but, as nearly as I can recollect, I should say it took fully ten minutes. The working of the apparatus was very irregular. At times nothing issuing from the exit-pipe, and at other times a sudden discharge of fat and vapor and water, which confused us a good deal.

X Q. 56. At what heat was the apparatus when it took ten minutes for the mixture to pass through?

A. I cannot state positively. I did not handle the thermometers, which were made of wires, operating in tubes, said to contain tin, lead, and other metals and alloys.

X Q. 57. Can you testify that the direction of the patent, "that no steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture," was accurately complied with?

A. I believe it was, if it is possible to comply with it.

X Q. 58. Cross-question 57 repeated.

A. If there was any short-coming in that respect, it was from an impossibility in effecting that end, and not a defect in working the apparatus, in my opinion.

X Q. 59. Were you examined as a witness in the case of Richard A. Tilghman against Roland G. Mitchell, in April, 1868, respecting the experiments in Cincinnati you have just referred to?

A. I was.

X Q. 60. Did you not then testify that you did not know how long the mixture took in passing through the coil?

A. I believe I did. I cannot state from memory; but by referring to a copy of the deposition I find that I did.

X Q. 61. Did you not then testify that you could not testify that the direction of the patent, "that the mixture while flowing through the tubes should be retained at the desired temperature (melting lead) for ten minutes before passing into the refrigerator, was accurately complied with?"

A. I believe I did.

X Q. 62. Were you not then asked, "Can you testify that the
886 directions of the patent, 'that no steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture,' was accurately complied with," and did you not then reply, "No, I cannot?"

A. I believe that question was put, and that was my answer.

X Q. 63. In your answer to Cross-question 58, you state, "If there was any short-coming in that respect, it was from the impossibility in

effecting that end." Please explain how many, and what, variations of the experiment you have made to enable you to say that there was an impossibility in effecting that end.

A. I never made any experiments, or witnessed any other than the one referred to.

X Q. 64. In the experiment at Cincinnati, what, in your opinion, would have been the effect of increasing the pressure on the exit-valve, as regards the regularity of the discharge?

A. I do not believe it would have changed it any; I believe it would have made it worse.

X Q. 65. In your answer to Direct Question 23 you have referred to the Wright & Fouché apparatus. Please state what is the efficient agent in converting the fat into fat acids and glycerine in that apparatus.

A. Water, alone, at a high heat under a pressure.

X Q. 66. In that apparatus, has the circulation any other effect than to produce mixture and contact of the fat and water?

A. None that I know of; and I do not know why it should operate any better than the apparatus now recommended by Mr. Tilghman. They all seem to me to operate under the one principle.

X Q. 67. If one-half per cent. of lime were used in the Wright & Fouché apparatus, the heat, pressure and circulation remaining the same, would not the decomposition be effected in a shorter time, in your opinion?

A. Yes; I think there is no doubt of that.

Examination adjourned to to-morrow, (Tuesday,) at 2 o'clock p. m.

TUESDAY, *June 8th—2 p. m.*

Present: B. C. Tilghman, esq., for complainant; Charles B. Collier, esq., for defendants.

887 Cross-examination of Charles H. Grant resumed:

X Q. 68. Can you, as a manufacturer, form a reliable opinion as to whether a fat is well decomposed into fat acids from inspection and handling merely, or would it be necessary to press or otherwise work it to enable you to form a reliable opinion?

A. I think it would be necessary to press or otherwise work some fats.

X Q. 69. How would it be in the case of tallow?

A. It would be necessary to press or otherwise work it, I think.

X Q. 70. Did you not obtain, and if so when, from the Ohio Candle Company ten thousand pounds of tallow decomposed by them into fatty acids by the water process, under license from complainant?

A. We did obtain, I think, in 1867, about ten thousand pounds, which I supposed to be decomposed tallow, and which, they alleged, had been decomposed by said process.

X Q. 71. As far as you know or believe, was that fat acid as well decomposed as the average product of the Ohio Candle Company?

A. I suppose it was. I directed them to have it thoroughly decomposed.

X Q. 72. As far as you could form an opinion from the mere inspection and handling of that fat acid, and before having pressed or worked it, did you judge it to be thoroughly decomposed?

A. I did.

X Q. 73. After having pressed and worked it, what was your opinion as to its being thoroughly decomposed?

A. I don't think I changed my opinion.

X Q. 74. What was your object in getting that fat acid from the Ohio Candle Company?

A. To see whether we could make good candles out of stuff decomposed by them, and do it profitably.

X Q. 75. Do the Ohio Candle Company, and Ropes & Co., of Cincinnati, Ohio, make good merchantable candles?

(Question objected to as being immaterial and incompetent.)

888 A. I believe Ropes & Co. do, and the Ohio Candle Company make some, and some very poor ones. I havn't seen a sample of either, I think, for a year.

X Q. 76. Was the apparatus used by you, from 1859 to 1862, in working the water process under complainant's license, substantially similar to that drawn and marked Figure 1 on the sheet of drawings now shown you, marked Complainant's "Exhibit Grant, No. 1?"

A. Yes.

X Q. 77. Is the apparatus used by N. Ropes & Co., of Cincinnati, substantially similar to Figure 1 on said sheet of drawings?

A. Yes, to all appearances.

X Q. 78. From your knowledge of the working of the water process by yourself and others, what other conditions are necessary for a satisfactory decomposition of neutral fats into fat acids and glycerine, besides these three—an intimate mixture of the fat and water and a high temperature and pressure during a sufficient length of time?

A. I don't know.

X Q. 79. Do you know of any manufacturer in the United States, besides yourself, who, after having once adopted the water process of decomposing fats, has abandoned it for any other process?

(Objected to by counsel for defendants, inasmuch as there is no evidence showing that any manufacturer in the United States, other than R. G. Mitchell, in New York, decomposes fats by the action of water, unaided by lime, and therefore no evidence of the use of "the water process" referred to in the question.)

A. I do not.

X Q. 80. State, from the best of your information and belief, whether the following-named manufacturers have not, at some time during the past ten years, been working under a license from complainant to use his process, patented October 3d, 1854, to wit, N. Ropes & Co., Cincinnati; Ohio Candle Company, Cincinnati; Proctor & Gamble, Cincinnati; W'm H. Woods & Co., Cincinnati; M. Werk & Co., Cincinnati; George Shillito, Cincinnati; Cornwall & Brother, Louisville, Ky.; N. Shaeffer & Co., St. Louis, Mo.; Goodwin, Behr & Co., St. Louis; E.

889 Schneider & Co., Chicago; A. Gross & Co., New York. Name particularly any one as to whom you have no information or belief.

(Objected to by counsel for defendants, inasmuch as the question calls for secondary and hearsay evidence; the production of the licenses, if such there be, being the proper and necessary mode of proof of the fact.)

A. I have no information as to M. Werk & Co., George Shillito, or E. Schneider & Co. My supposition has been that M. Werk & Co. and George Shillito & Co. were not working under such licenses. The others I believe to have been working under such licenses. The first four named in the question have told me that they were working under such licenses.

(Answer objected to as being merely hearsay testimony.)

X Q. 81. Do you not know that Mr. Henry Bower was extensively engaged in refining glycerine in Philadelphia in the year 1867, and for several years prior?

A. I do not know it. I believe it to be so.

X Q. 82. By the old lime-saponification process, how many pounds of fat acid did you obtain from one hundred pounds of fat?

A. I think about ninety-three from good tallow.

X Q. 83. In that process was there not a considerable loss of fatty acid from its becoming entangled with the mud of sulphate of lime produced, and being thrown away with that refuse?

A. I believe there was some loss, but how much I cannot state. I find a difficulty in answering this and many other questions put to me, because I have been the mercantile and not the manufacturing partner, and have not been intimately acquainted with the details of manufacturing, as I otherwise would have been.

X Q. 84. Do you know of any other source of loss of fatty matter in the old lime-saponification process, except this?

A. I do not.

X Q. 85. If the quantity of refuse sulphate of lime produced was very much diminished, say to one-fourth of the former quantity, would not this loss of fatty acid entangled in it be proportionately diminished?

A. I think it would.

890 X Q. 86. When working the Tilghman process, did you sell the glycerine produced, and to whom, and at what price?

A. We sold it to Henry Bowen for one-half the net proceeds of his sales, whatever that might be.

X Q. 87. How did the sum thus received by you for glycerine compare with the sum paid to Mr. Tilghman for license?

A. We received more than we paid.

Re-examination:

Q. 88. How would the solution of glycerine or glycerine-water produced by you in the so-called Tilghman process have compared in value with the glycerine solution produced in the ordinary lime-saponification process?

A. It would be more valuable, because more highly concentrated. That produced by the old lime-saponification process would, I suppose, be worth the difference of cost of concentration less than the other.

Q. 89. Would that be a material difference?

A. I think not.

Q. 90. During the year 1867, as before and since, the business of Mr. Bowen was not that of a manufacturer of glycerine or fatty acids, but his business was to purchase glycerine-water from manufacturers, and concentrate and purify it, was it not?

A. I believe it was.

Q. 91. In your answer to Cross-question 68 you state that you think it would be necessary to press or otherwise work some fats in order to form a reliable opinion as to whether they are well decomposed into fat acids. Have you at any time so tested or otherwise carefully examined the fats steamed by you, in order to ascertain whether such steaming as described by you in your answer to Cross-question 38 had acidified such fats?

A. No. I never thought of such a thing. It never presented an appearance which would suggest such idea to me, and I have never heard it suggested before.

Q. 92. Might it not have been partially acidified or decomposed with-

out your knowing the fact, or being able to know it without an examination made for the purpose of so ascertaining?

A. It might, but not, I think, to any considerable extent to make
891 it practically available. We rarely or never, except at the commencement of our adoption of the distillation process, had a charge of pure neutral fat in our acidifiers, but always had some residues of former distillation mixed with it.

Recross-examination:

XX Q. 93. During the two or three years of your use of the old lime-saponification process, did you ever sell any glycerine-water whatever at any price?

A. I don't think we did. Powers & Weightman got a few casks of it, I think. I do not know whether they paid for it or not.

XX Q. 94. Look at the papers now produced, marked "Complainant's Exhibit Grant, No. 2, and Grant No. 3," and state whether they are the original agreements made between you and the complainant respecting your license to use his process patented October 3d, 1854.

(Objected to for the reason that the said papers are irrelevant, and have no connection whatever with this suit.)

A. They are.

Re-examination:

Q. 95. If at the time you were using the old lime-saponification process you had also been using the so-called Tilghman process, what difference, if any, would there have been in the value of the glycerine-water produced by each process, respectively?

A. The difference of handling so large a bulk of water and concentrating that which was produced by the old process.

Q. 96. Was there any market for glycerine-water at that time?

A. We had none. It seemed to be just coming to the notice of our chemists.

C. H. GRANT.

Q. 97. In the old lime-saponification process, if the same quantity of water is employed as provided in the complainant's patent, to wit, one-third to one-half the quantity of fat, would not the glycerine-solution be as concentrated as that produced from the Tilghman process? And if so, what difference, if any, would there be in its value?

892 A. I have no experience or knowledge to enable me to answer the question.

C. H. GRANT.

Sworn June 4th, and subscribed before me this 8th day of June, A. D. 1869.

WM B. DAYTON,
Notary Public and Special Examiner.

Examination adjourned to to-morrow, (Wednesday,) June 9th, at 2 o'clock p. m.

WEDNESDAY, *June 9th—2 p. m.*

Present: B. C. Tilghman, esq., for complainant; Charles B. Collier, esq., for defendants.

JOHN CAMPBELL, a witness produced on behalf of the defendants, being first duly and solemnly sworn, deposes and says:

Question 1. Please state your age, your place of residence, and your occupation.

Answer. My age is fifty-eight. I reside at 2016 Green street, Philadelphia; am a bookseller.

Q. 2. For how long have you been in such business in the city of Philadelphia?

A. Almost twenty years.

Q. 3. What facilities, if any, have you had for becoming acquainted with the public journals and newspapers published in said city?

A. Nothing beyond common report, and as an advertiser wishing to ascertain which would have the greatest circulation.

(Counsel for defendants introduces a copy of the Universe, marked "Defendants' Exhibit Campbell, No. 1," which is shown to the witness.)

Q. 4. What knowledge, if any, have you of a newspaper called the Universe, a copy of which is now shown you, as to its standing and its character as a medium of advertisement in said city of Philadelphia?

893 A. All I know of the paper is this, that I have been solicited to advertise in it, and, upon inquiry, was informed that its circulation was too small, and that it would not pay me to advertise in it. I have never, that I remember, seen a copy of the paper until the one now presented me, and do not know of any file of it to be found in the city. I am a Roman Catholic.

Cross-examination waived.

JOHN CAMPBELL.

Sworn to and subscribed before me this 9th day of June, A. D. 1869.

WM B. DAYTON,
Notary Public and Special Examiner.

Counsel for defendants offers in evidence a certified copy of the file contents in the matter of the letters-patent granted R. A. Tilghman, dated October 3d, 1854, No. 11766.

Also, certified copy of the account of receipts and disbursements of Richard A. Tilghman, filed by him in the Patent-Office in connection with his application for an extension of his said letters-patent.

Also, an agreed printed copy of letters-patent granted to Richard A. Tilghman on the 15th day of May, 1860, No. 28315, as contained on pages 249 to 255, inclusive, defendants' printed record in suit of R. A. Tilghman vs. R. G. Mitchell.

Also Comptes Rendues, French Academy, session of Monday, 3d of December, 1855. Title, Organic chemistry upon the saponification of neutral fatty bodies by the soaps. By M. J. Pelouze.

(Objected to.)

Also, Report of the jury of the French exhibition, Paris, 1855. Article entitled Stearic candles, aqueous saponification in a close vessel, &c. Page 486, et seq.

Also, certified copy of application of Richard A. Tilghman for extension, including affidavits, order for publication and hearing, examiner's report, etc.

894 It is hereby agreed that the testimony of N. Ropes, s'r, taken in the suit of R. A. Tilghman vs. M. Werk, (No. 1270,) as contained in the printed record of said cause, pages 109–111, and the testimony of same witness, taken in the suit of R. A. Tilghman vs. R. G.

Mitchell, as contained in the printed record of said cause, pages 7–21, may be read in evidence by either party at the hearing of this cause.

CHA'S B. COLLIER,
Counsel for Defendants.
B. C. TILGHMAN,
Counsel for Complainant.

PHILADELPHIA, *September 13th*, 1869.

895 Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL. } Second suit.

Additional testimony on the part of the defendant.

C. M. Keller, esq., and S. D. Law, esq., counsel for defendant; George Harding, esq., counsel for complainant.

New York: John Polhemus, steam book & job printer, No. 102 Nassau street, 1871.

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897 U. S. circuit court, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

Testimony taken on the part of the complainant for final hearing under and pursuant to the 67th rule of the Supreme Court of the United States, as amended September 29th, 1871. Present: B. C. Tilghman, esq., counsel for complainant, and R. A. Tilghman, the complainant in person; and S. D. Law, counsel for defendant, and defendant in person.

J. EUGENE MATHEWSON, being called and duly sworn on the part of the complainant, deposes and says:

Q. 1. What is your name, age, residence, and occupation?

A. My name is J. Eugene Mathewson; 31 years of age. I reside in Philadelphia, Pa. I am a machinist, in the employ of Mr. Tilghman, the complainant.

Q. 2. Have you lately examined the files of the National Intelligencer, a newspaper of Washington, D. C., for the year 1867? If so, state when and where, and at whose request, you made said examination?

A. I have made such examination at the Mercantile Library, in Philadelphia, on the 21st of Sept., 1871, at the request of B. C. Tilghman.

Q. 3. How many notices of applications for the extension of patents were published in said paper during the year 1867?

898 A. I found one hundred and one notices of applications.

Q. 4. State whether the said 101 notices contained orders of publication in any newspapers; and if so, in what?

A. They did. They were all ordered to be published in the Republican and the Intelligencer of Washington, D. C., and also in one other paper, which was generally published at the residence of the patentee.

Q. 5. State how many of said 101 applications were from residents of the city of New York, and how many from residents of Philadelphia; Boston; Lowell, Mass.; Springfield, Mass.: and Cleveland, Ohio, respectively.

(Objected to by defendant's counsel as irrelevant and immaterial.)

A. 13 were from New York; 7 from Philadelphia; 3 from Boston; 3 from Lowell, Mass..; 5 from Springfield, Mass; and 2 from Cleveland, Ohio.

Q. 6. State in what newspapers (besides the Intelligencer and the Republican of Washington, D. C.,) the applications of the residents of each of said cities were ordered to be published.

(All right of objection to this examination or the several questions thereof reserved by defendant's counsel.)

A. They were all ordered to be published in a newspaper published at the city where the patentee resided.

Q. 7. State in what Philadelphia newspapers the seven applications from residents of Philadelphia were ordered to be published?

A. They were ordered to be published in the Inquirer, Telegraph, and Universe—three in the Telegraph, two in the Inquirer, and two in the Universe.

Q. 8. How many times, and at what dates, was the application for extension of Richard A. Tilghman, of Philadelphia, published in the National Intelligencer of Washington?

A. It was published seven times, on April 6, 9, 10, 11, 12, 19 and 23.

899 Q. 9. Have you seen the said notice of the application of R. A. Tilghman published in any newspapers other than the Intelligencer and the Republican of Washington, and the Universe of Philadelphia? If so, state in what newspapers, how often, and at what dates said application was published.

A. I have. In the Daily Morning Chronicle of Washington, D. C., on April 8, 15, and 22, 1867; also in the Evening Star of Washington, D. C., April 8, 13, and 20, 1867.

Q. 10. Have you ascertained how many notices of applications for extensions of patents are contained in the lists published in the Scientific American, of New York, during the year 1867? If so, state how you ascertained it, and what was the number.

A. I have. I examined the index for the applications for extensions of patents, and noted down the pages that they were to be found upon, and afterwards referred to each page and put down the number I found. In the 1st volume for 1867 I found 34; in the 2d volume for 1867 I found 39; making for the whole year 73.

Cross-examined by Mr. Law:

X Q. 11. Can you give the names of all the residents of Philadelphia, in whose names you found notices of applications for extension for 1867 in the National Intelligencer, as you have stated?

A. I can. George Sharp, R. A. Tilghman, George T. Parry, L. B. Flanders, M. Stewart, Joseph Knock, and William Mann.

X Q. 12. Which of these seven notices of application were ordered to be published in the Universe also?

A. William Mann and R. A. Tilghman.

X Q. 13. Did such notices specify the names of the persons appearing as attorneys in the matter of such applications?

A. They did not.

X Q. 14. Give the dates, if you know, when the notice of application

for extension of R. A. Tilghman was published in the Universe and Republican.

A. I have not examined those papers.

900 X Q. 15. You have stated that the 101 notices of application for extension found in the Intelligencer for 1867 were also ordered to be published in the Republican as well as in the Intelligencer, "and also in one other paper, which was generally published at the residence of the patentee." Have you any knowledge as to the residences of such patentees except that derived from the several notices themselves, which you found in the paper examined by you?

A. I have not.

J. EUGENE MATHEWSON.

Subscribed and sworn to before me this 29th day of September, 1871.

R. E. STILWELL, *Examiner.*

Counsel for defendant gives notice to the complainant that he shall, upon the argument of this cause, refer to letters-patent No. 15129, granted on the 28th February, 1856, for 15 years, to M. Tilghman, of Philadelphia, "Pour des perfectionnements dans le traitement des corps gras," which patent he puts in evidence as an exhibit in this cause, and consents that the complainant may introduce any documentary evidence in relation thereto, if he desires.

Counsel for complainant objects that the time for the taking of testimony for defendant was closed by order of the court on the 15th September, 1871; and further objects that no copy of said patent is now produced and filed as an exhibit, or in any way proved or identified; and further objects to such evidence as irrelevant and incompetent.

Defendant's counsel does not now produce a copy of such patent because he has only a rough copy, which he is unable to say is a correct copy, but he has referred to the date and number of the patent, and will file with the court a correct copy made from the official publication of the French government of patents issued, namely, the brevets d'invention, and will also serve a copy of such on the complainant's counsel.

Testimony closed.

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No. 1. McIntire's letter to Keller, Nov. 23, 1867, put in p. 5, printed 49
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No. 6. Specimen of candles mentioned by witness Grant 52
No. 7. Copy of Order of Patent-Office, March 16, 1867, on petition of R. A. Tilghman for extension of his patent, put in p. 21, printed 52
No. 8. Copy of file and contents in the matter of R. A. Tilghman's application for extension of his patent, put in p. 21, printed ... 54
No. 9. Copy of certain papers, testimony, etc., in the matter of R. A. Tilghman's application for extension of his patent, put in p. 21, printed 89
No. 10. Copy of entry of book containing lists of patents for 1867, put in p. 22, printed 97
No. 11. Copy of file and contents in the matter of letters-patent granted Richard A. Tilghman, dated Oct. 3, 1854, and antedated Jan. 9, 1854, No. 6,801, put in p. 34, printed 98
R. A. Tilghman's British patent 113
R. A. Tilghman's French patent, 1854 123
R. A. Tilghman's French patent, 1856, put in as an Exhibit by defendant, Sept. 20th, 1871 128

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903 Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

It is hereby stipulated and agreed, by and between the parties to the above suit, and their respective solicitors, that the testimony and exhibits heretofore taken and filed in the suit of R. A. Tilghman v. M. Werk, in the circuit court of the United States for the southern district of Ohio, and in the former suit of R. A. Tilghman v. R. G. Mitchell in this court, and in the reference in said last mentioned suit, under the decree therein, to Kenneth G. White, esq., one of the masters of said court, and in the suits of R. A. Tilghman v. M. Werk, T. Kirby, and others, and R. Tilghman v. G. Shillito, in the circuit court of the United States for the southern district of Ohio, as the same are contained in the printed records of the parties in said suits and proceedings, may be read and used at the hearing of this suit with the same effect as if they had been originally taken and filed herein, either party to be entitled to put in additional testimony, with right to the other party to reply thereto.

904 It is also agreed that the letter of R. A. Tilgham, dated London, June 25, 1856, and the letter of J. P. Wilson, dated London, July 13, 1865, as contained on pages 326 to 329 of complainant's printed record in the suit of Tilghman v. Werk, Kirby, and others, and admitted therein (page 326) to be genuine communications, are admitted in like manner so to be in the present suit.

It is also agreed that the prima facie testimony on the part of the com-

plainant in this suit is now closed, and that the testimony on the part of the defendant shall be closed within sixty days from this date.

Dated May 30, 1871.

GEORGE HARDING,
Per B. C. TILGHMAN,
Solicitor for Complainant.

S. D. LAW,
Solicitor for Defendant.

Time for defendant to put in testimony further extended by order of court to and including Sept. 15, 1871.

And further extended by agreement of parties to and including Sept. 18, 1871.

905 U. S. circuit court, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

Testimony taken on the part of the complainant for final hearing under and pursuant to the 67th rule of the Supreme Court of the United States, as amended September 29th, 1871. Present: B. C. Tilghman, esq., counsel for complainant, and R. A. Tilghman, the complainant in person; and S. D. Law, counsel for defendant, and defendant in person.

J. EUGENE MATHEWSON, being called and duly sworn on the part of the complainant, deposes and says:

Q. 1. What is your name, age, residence, and occupation?

A. My name is J. Eugene Mathewson; 31 years of age. I reside in Philadelphia, Pa. I am a machinist, in the employ of Mr. Tilghman, the complainant.

Q. 2. Have you lately examined the files of the National Intelligencer, a newspaper of Washington, D. C., for the year 1867? If so, state when and where, and at whose request, you made said examination.

A. I have made such examination at the Mercantile Library, in Philadelphia, on the 21st of Sept., 1871, at the request of B. C. Tilghman.

Q. 3. How many notices of applications for the extension of patents were published in said paper during the year 1867?

906 A. I found one hundred and one notices of applications.

Q. 4. State whether the said 101 notices contained orders of publication in any newspapers; and if so, in what.

A. They did. They were all ordered to be published in the Republican and the Intelligencer of Washington, D. C., and also in one other paper which was generally published at the residence of the patentee.

Q. 5. State how many of said 101 applications were from residents of the city of New York, and how many from residents of Philadelphia; Boston; Lowell, Mass.; Springfield, Mass.; and Cleveland, Ohio, respectively.

(Objected to by defendant's counsel as irrelevant and immaterial.)

A. 13 were from New York; 7 from Philadelphia; 3 from Boston; 3 from Lowell, Mass.; 5 from Springfield, Mass.; and 2 from Cleveland, Ohio.

Q. 6. State in what newspapers (besides the Intelligencer and the Republican of Washington, D. C.,) the applications of the residents of each of said cities were ordered to be published.

(All right of objection to this examination, or the several questions thereof, reserved by defendant's counsel.)

A. They were all ordered to be published in a newspaper published at the city where the patentee resided.

Q. 7. State in what Philadelphia newspapers the seven applications from residents of Philadelphia were ordered to be published.

A. They were ordered to be published in the Inquirer, Telegraph, and Universe—three in the Telegraph, two in the Inquirer, and two in the Universe.

Q. 8. How many times, and at what dates, was the application for extension of Richard A. Tilghman, of Philadelphia, published in the National Intelligencer of Washington?

A. It was published seven times, on April 6, 9, 10, 11, 12, 19, and 23.

Q. 9. Have you seen the said notice of the application
907 of R. A. Tilghman published in any newspapers other than the Intelligencer and the Republican of Washington, and the Universe of Philadelphia? If so, state in what newspapers, how often, and at what dates said application was published.

A. I have. In the Daily Morning Chronicle of Washington, D. C., on April 8, 15, and 22, 1867; also, in the Evening Star of Washington, D. C., April 8, 13, and 20, 1867.

Q. 10. Have you ascertained how many notices of applications for extensions of patents are contained in the lists published in the Scientific American, of New York, during the year 1867? If so, state how you ascertained it, and what was the number.

A. I have. I examined the index for the applications for extensions of patents, and noted down the pages that they were to be found upon, and afterwards referred to each page and put down the number I found. In the 1st volume for 1867 I found 34; in the 2d volume for 1867 I found 39; making for the whole year 73.

Cross-examined by Mr. Law:

X Q. 11. Can you give the names of all the residents of Philadelphia in whose names you found notices of applications for extension for 1867 in the National Intelligencer, as you have stated?

A. I can. George Sharp, R. A. Tilghman, George T. Parry, L. B. Flanders, M. Stewart, Joseph Knock, and William Mann.

X Q. 12. Which of these seven notices of application were ordered to be published in the Universe also?

A. William Mann and R. A. Tilghman.

X Q. 13. Did such notices specify the names of the persons appearing as attorneys in the matter of such applications?

A. They did not.

X Q. 14. Give the dates, if you know, when the notice of application for extension of R. A. Tilghman was published in the Universe and Republican.

A. I have not examined those papers.

908 X Q. 15. You have stated that the 101 notices of application for extension found in the Intelligencer for 1867 were also ordered to be published in the Republican as well as in the Intelligencer, "and also in one other paper, which was generally published at the residence of the patentee." Have you any knowledge as to the residences of such patentees except that derived from the several notices themselves which you found in the paper examined by you?

A. I have not.

J. EUGENE MATHEWSON.

Subscribed and sworn to before me this 29th day of September, 1871.
R. E. STILWELL, *Examiner.*

Counsel for defendant gives notice to the complainant that he shall, upon the argument of this cause, refer to letters-patent No. 15129, granted on the 28th February, 1856, for 15 years, to M. Tilghman, of Philadelphia, "Pour des perfectionnements dans le traitement des corps gras," which patent he puts in evidence as an exhibit in this cause, and consents that the complainant may introduce any documentary evidence in relation thereto, if he desires.

Counsel for complainant objects that the time for the taking of testimony for defendant was closed by order of the court on the 15th September, 1871; and further objects that no copy of said patent is now produced and filed as an exhibit, or in any way proved or identified; and further objects to such evidence as irrelevant and incompetent.

Defendant's counsel does not now produce a copy of such patent because he has only a rough copy, which he is unable to say is a correct copy, but he has referred to the date and number of the patent, and will file with the court a correct copy made from the official publication of the French government of patents issued, namely, the brevets d'invention, and will also serve a copy of such on the complainant's counsel.

Testimony closed.

909 Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

Testimony taken on part of the defendant for final hearing, under and pursuant to the 67th rule of the Supreme Court of the United States, as amended.

THURSDAY, *September* 7, 1871.

Present, S. D. Law, counsel for defendant; and George Harding and B. C. Tilghman, counsel for complainant.

WM C. MCINTIRE, being called and duly sworn as a witness on the part of the defendant, deposes and says as follows:

Q. 1. What is your name, age, residence, and occupation?

A. William C. McIntire; 30 years of age. I reside at Washington City, D. C., and am a solicitor of patents. I have resided there all my life, nearly.

Q. 2. Were you employed by anybody in this city to make any enquiries, or do anything in connection with the application of R. A. Tilghman in 1867, for the extension of his patent, granted or dated January 9, 1854? If so, by whom, and when, and state what was done by you?

(Objected to as irrelevant and immaterial.)

910 A. I was, by Charles M. Keller and S. D. Law, on the 23d of November, 1867. On that day I called at the examiner's room early in the morning, at the Patent-Office, under instructions contained in a letter received by me that morning from Mr. C. M. Keller, and made enquiry as to whether an application for the extension of R. A. Tilghman's patent of January 9, 1854, for "decomposing fatty substances,"

had been filed. The examiner was not in, but his assistant informed me that no such application was on file. I told him that it was strange, and called on the clerk in the draughtsman's room, who has charge of such cases, and asked him if said application had been filed. He immediately replied that it had. I told him that the examiner thought differently, and he requested me to accompany him to the examiner's room, which I did. We found that the examiner had returned, and the draughtsman's clerk walked to the desk and handed me the box containing the application. I told the examiner that I was about to order copies of all the papers on file, and asked if he could inform me whether I could get the books which appeared as exhibits outside of the office. He said he thought I could, and we had some little conversation, which left the inference plain that the copies were needed for the purpose of opposition. I immediately thereafter ordered, from the Patent-Office, copies of all the papers on file, except the two exhibits alluded to. I did nothing more in this case until the 29th of November, when I replied by telegram and letter to a communication from S. D. Law, inclosing notice of opposition on the part of R. G. Mitchell, which was received by me the day previous, and requesting me to file said notice. I telegraphed him on that day that the extension had been ordered granted, and wrote on the same day, saying that the office was closed the day prior. I further telegraphed on that day that the patent had not left the building.

911 (Mr. Harding objects to the testimony as to conversations, and the statements made by and to the witness, and as to impressions left by him.)

Q. 3. Have you the original letters received by you, written to you by Mr. Keller and Mr. Law? If so, produce them, or explain why you have not them; and produce, if you have them, your answers to such letters.

(Same objection as before.)

A. I have not the letters to me. They became lost or mislaid upon my removal to New York City, in the month of January, 1868. I have my answers, and produce them.

(The question and production of the letters objected to on the same ground as before.)

The answers to letters above referred to by witness are put in evidence by counsel for defendant, and the same are marked "Defendant's Exhibits 1 and 2, September 7, 1871, R. E. S., ex'r."

Q. 4. Were you present afterwards at any interview with the Commissioner of Patents as to such extension; and, if so, who were present at that interview, and what was said by the Commissioner of Patents in reference thereto and in reference to testimony on the part of R. G. Mitchell in opposition to such extension?

(Objected to as before.)

A. I was with Mr. Law and Mr. Mitchell. The Commissioner said the defendant might go on taking his testimony, and that he would take no further action in the matter of the extension until the last mo-
912 ment; and if the defendant's testimony showed good reason for not granting the extension he would with'old it, unless compelled by mandamus to do otherwise, at the same time making provision for his action to be based upon the legality of the testimony.

(Conversation objected to.)

Q. 5. How long after your first action in this matter was this interview with the Commissioner?

(Objected to as before.)

A. About ten days.

Q. 6. At the time of this interview had the extension of the patent been actually made, and the patent gone from the office, if you know?

(Objected to as before, and because the records of the office are the proper proofs of its action.)

A. The order had been endorsed upon the file, but the patent had not left the office.

Q. 7. State, if you know, when the patent, as extended, left the office, and from what source you have derived your knowledge.

(Objected to as before.)

A. On the 14th of December, 1867. I derive my knowledge from the record of the Patent-Office, kept in the room from which the patents are sent.

Q. 8. When first did you learn that such patent, as extended, had left the Patent-Office, and what communication, if any, did you make to Mr. Keller or Mr. Law in reference thereto?

(Objected to as before.)

A. On the 20th of December, 1867, I telegraphed Mr. C. M. Keller that the patent left the office the Monday previous.

913 Q. 9. When you first went, on the morning of November 25, 1867, to the examiner's room to inquire as to Tilghman's application for an extension, had the patent at that time been extended, or any decision made by the examiner in reference to such extension, as appeared from the files in that case?

(Objected to as before, and because the record is the best evidence.)

A. There had not.

WM C. McINTIRE.

Sworn and subscribed to before me this 7th day of September, 1871.

R. E. STILWELL,
Examiner, Etc.

STEPHEN D. LAW, being called and duly sworn as a witness on part of the defendant, deposes and says as follows:

I am a counsellor at law, doing business in the city of New York, and have been acting for R. G. Mitchell, the defendant in this case, since January, 1867. Mr. Mitchell, early in 1867, called my attention to the fact that the patent of R. A. Tilghman, of January 9, 1854, for "manufacturing fatty acids and glycerine," or "purifying fatty bodies," would soon expire, and that he wished me to learn if any application for an extension of such patent was made, and to take the necessary steps to oppose any such application upon his (Mr. Mitchell's) behalf.

(Mr. Harding objects to the foregoing statement as irrelevant and immaterial, and as incompetent evidence; and it is understood that Mr. Harding reserves the right to continue this objection by making a note at the end of this deposition.)

914 Witness continues: In accordance with such request, I examined, from week to week, the issues of the Scientific American and the American Artisan, in which notices of extension were generally published; but finding no reference to any such application in such papers, on the 19th day of November, 1867, I addressed a letter to the Patent-Office, asking whether any application for the extension of such patent had been made; and, if so, when the hearing of such application was set for, and when objections thereto were to be filed, to which

I received an answer, written in pencil upon the bottom of the letter sent by me to the Patent-Office, as follows:

"App. for ext'n filed March 16, '67. Hearing June 17, '67. Probably extended.

(Signed) "A. M."

I immediately, upon the receipt of such information, which reached me on the 22d of November, 1867, prepared a notice of appearance in opposition to such application for such extension, and sent a copy of the same to be served on the applicant, and also sent a copy to W. C. McIntire, at Washington. These copies were sent by me on the 27th day of November, copies of the papers filed by R. A. Tilghman, in his application, having been ordered in the meantime by Mr. Keller, with whom I had been consulted as to such matter. On the 29th day of November I received from Mr. McIntire, at Washington, a telegram that Tilghman's patent had been extended, or the extension granted on the 23d of November, to which I sent a reply, inquiring if the patent had actually left the office, to which I received an answer that the patent had not actually gone out of the office, but would in a day or two.

(The telegram first received, November 29, 1867, is put in evi-
915 dence by defendant's counsel, and the same is marked "Exhibit No. 3, Sept. 7, 1871, R. E. S., ex'r."

And the second telegram received that day is put in evidence and marked "Exhibit No. 4, Sept. 7, 1871, R. E. S., ex'r."

The letter written by the witness on November 19, 1867, to the Patent-Office, is also put in evidence, with the answer therein, by defendant's counsel, and marked "Defendant's Exhibit No. 5, Sept. 7, 1871, R. E. S., ex'r.")

Witness continues: On the following day, November 30, I received from Mr. McIntire a letter, to which he has referred, and which is marked Defendant's Exhibit No. 2. Upon receiving such telegram and Mr. McIntire's letter, I sent word to Mr. R. G. Mitchell, and went with him to Washington to see the Commissioner in reference to the said extension. On the 2d day of December—I believe that was the date—I called upon Mr. Theaker, the then Commissioner of Patents, in reference to such extension, and whether opposition could be made thereto as the matter then stood. The Commissioner said he had actually extended the patent, by approving or confirming the decision of the examiner in favor of such extension, and he seemed to doubt whether he had the power to revoke or annul such approval. I claimed that the patent was wholly under his control until it had been actually sent out of the Patent-Office, and that the Commissioner of Patents necessarily had the right to reconsider any action that had been taken in a case like the one then in consideration, and insisted upon the right of Mr. Mitchell to put in testimony in opposition to Mr. Tilghman's application for the extension of his patent. After some considerable conversation with the Commissioner, he told me that, although he would not revoke his order or approval given by him for the extension, that
916 Mr. Mitchell should have the privilege of putting in any testimony that he desired in the case, and that no final action should be taken therein until just previous to the time when the patent would expire, and that he would examine and consider any testimony that Mr. Mitchell should put in in the case, and that, if the testimony put in should show that the patent ought not to be extended, he would not extend it, although he had made the order he had made, unless he was compelled by a mandamus. The Commissioner, while giving this op-

portunity to put in testimony, said that he should reserve all questions as to the relevancy of the testimony offered, and whether he had the power to go behind his approval already made, to which reservation no objection was made by me. I immediately returned to New York, gave notice to Mr. Tilghman and his counsel, Mr. Harding, of taking testimony in opposition to such application for an extension, for December 10, and, under such notice, took testimony on the 10th, 11th, 12th, and 13th of December, which testimony was sent to the Patent-Office on the 17th or 18th of December, 1867. A stipulation was also made in such matter between myself and Mr. Harding, admitting for consideration in such application the testimony of certain witnesses who had been examined in Ohio, in May, 1867, in a suit pending in the United States circuit court for the southern district of New York, between said Tilghman and said Mitchell. The testimony referred to in such stipulation was also sent by me to the Patent-Office on the 17th of December, I think, and the 20th of December, Mr. Keller, my associate counsel in opposing such extension, sent me a telegram, which is as follows, and which was directed to said Keller, and signed by W. C. McIntire:

"WASHINGTON, *Dec.* 20.

"C. M. KELLER, Esq., *Park Row, N. Y.:*

917 "Meyer's extension patent goes to you Monday. Don't go to any further trouble in Tilghman's extension. Patent was delivered on Monday.

W. C. McINTIRE."

Witness continues: Upon receiving such telegram, nothing further was done by me in the case.

(In pursuance to the foregoing reservation Mr. Harding objects to the whole of the foregoing testimony as irrelevant and immaterial, and further objects as to the hearsay statements and conversations, and as to matters of which the records of the office are the best proof; and also as to the admissibility of the several exhibits and dispatches.)

S. D. LAW.

Subscribed and sworn to before me this 7th day of September, 1871

R. E. STILWELL,
Examiner, Etc.

Adjourned to Saturday, 9th instant, at 11 a. m.

SATURDAY, *September* 9, 1871.

Present, counsel as before.

CHARLES H. GRANT, being called and duly sworn as a witness on part of the defendant, deposes and says as follows:

Q. 1. Have you been heretofore examined in a suit between the same parties with reference to the patent of the complainant of January 9, 1854?

A. I don't know the date of that patent, but I think I can say I have.

918 Q. 2. Were you examined in behalf of this defendant in Philadelphia, in April, 1868?

A. I was.

Q. 3. Are you still engaged in decomposing fats?

A. I am.

Q. 4. Is your present method of working the same that it was in April 1868, when you before testified?

A. It is.

Q. 5. By what name is the process used by you known, and do you produce thereby glycerine, or is the glycerine destroyed?

A. It is known by the name of sulphuric-acid or distillation process. The glycerine is destroyed.

Q. 6. Were you using that process in 1867, and when did you commence to use that process?

A. We were using it in 1867, and we first commenced to use it about 1854. We intermitted it for about a year. I can't recall the date.

Q. 7. In 1869, did you know of other persons in the United States who were engaged in the decomposition of fats into fat acids and glycerine, or a solution of glycerine?

A. I did.

Q. 8. In 1867, were there any person or persons in the city of Philadelphia, or State of Pennsylvania, engaged in the decomposition of fats into fat acids and glycerine, or the solution of glycerine?

A. There were none.

Q. 9. In that year was there anybody in Philadelphia, or the State of Pennsylvania, engaged in the decomposition of fats into acids besides yourself?

A. There were none.

Q. 10. Where did those persons reside who were engaged, in 1867, in decomposing fats into fat acids and glycerine, or a solution of glycerine, to whom you have referred?

919 (Mr. Tilghman, for the complainant, requests Mr. Law to state what is his object in this examination, and to what part of the case it refers.

Mr. Law replies that he considers the testimony pertinent to the issues raised by the answer in this case, and particularly all issues having any relation to the extension of the patent sued upon.

Mr. A. C. Tilghman objects to the questions and answers Nos. 7, 8, 9, and 10 as irrelevant and immaterial, and as being incompetent testimony.)

A. In New York, Cincinnati, Louisville, and St. Louis.

Q. 11. In 1867, were any persons other than the defendant in this suit, who carried on business in the city of New York, engaged in the manufacture of fats into fatty acids and glycerine, or a solution of glycerine, who were east of Cincinnati?

(Same objection.)

A. There were none except, perhaps, Mr. A. Gross, in Jersey City. I can't fix precisely in my mind when he commenced business.

Q. 12. Do you know whether Mr. Gross was a licensee of Mr. Tilghman under his patent?

(Same objection.)

A. From information and belief, I believe he was. I think Mr. Tilghman told me so, but am not certain.

Q. 13. Do you know of a paper published in the city of Philadelphia, in 1867, called the Universe, or Universe, Catholic Herald and Visitor?

(Same objection.)

920 A. I believe I have heard of it, but I don't know that I have ever seen it.

Q. 14. Was the Universe a paper of general or such circulation that business men advertised in it?

(Same objection.)

A. I suppose not, as I have never seen it, to my knowledge, in any business man's office, or in any news-room.

Q. 15. Did the defendant in this suit, R. G. Mitchell, purchase of you, during the last summer, some candles, and was the quality of such candles the same as that of candles you usually produced, or different; and are the candles now produced some of or like those purchased?

A. He did make such purchase, and these are the same quality and kind, and these are the same quality I usually make.

(The candles produced and testified to by the witness are put in evidence by defendant's counsel, and marked "Exhibit No. 9, Sept. 9, 1871. R. E. S., ex'r.")

(Same objection.)

Q. 16. Are you acquainted with the candles made by the licensees of Tilghman, the complainant?

(Same objection.)

A. I am.

Q. 17. How does the quality of the candles made by you compare with that of the candles made by Tilghman's licensees?

(Same objection.)

A. Ours are better than the average run of their candles, and bring a higher price in the market. By subsequent distillation, and by hard pressing, they can make a candle equal to ours, or superior if
921 they put the labor and expense upon it, and we could make a better candle by harder pressing.

Q. 18. Are you acquainted with the candles made by the defendant, R. G. Mitchell?

A. I am.

Q. 19. What is the difference, if any, in the market-value of the candles made by the defendant and those made by the licensees of Tilghman?

(Same objection.)

A. The candles made by the defendant sell from 6 to 8 cents a pound higher than those made by the licensees of Tilghman.

Q. 20. Do you know Thomas Emery & Sons; and if so, what is their business, and where do they carry it on, and by what process, and are they large or small manufacturers?

A. I know them; they manufacture fat acids by the sulphuric-acid or distillation process largely at Cincinnati.

Cross-examined by Mr. Tilghman:

X Q. 21. Cannot a manufacturer make from any average good quality of fat acids candles of every different grade of hardness and whiteness, according to the number and intensity of the pressings to which he subjects the material?

A. Yes, he can.

X Q. 22. Does Mr. Mitchell subject his material to two successive hot pressings?

A. He does.

X Q. 23. Could he produce the same quality without this double hot pressing or an equivalent extra length and intensity of a single hot pressing?

A. He could not.

Re-direct:

Q. 24. Is there not, in some processes of manufacturing candle
922 stock, an odor of acroleine communicated, which cannot be removed by any number of pressings or any intensity of pressings?

A. There is an odor of acroleine created in some processes of manufacture, but I cannot answer the question as to the possibility of removing it by an intense pressure.

Q. 25. From your experience in the manufacture of candles, what is your belief as to removing such odor by pressure?

A. I do not believe it could be entirely removed.

Q. 26. State, if you know, about what it would cost to double press candle-stock, as compared with single pressure.

A. The absolute cost of pressing would not exceed one-quarter of a cent a pound.

Q. 27. The increased value of the candles made by the defendant, as compared with the candles made by the licensees of Tilghman, is not, then, wholly due, is it, to the second hot pressing given by the defendant?

A. No; pressed in the same way the stock manufactured by the defendant would make a better candle than the licensees of Tilghman.

Recross:

X Q. 28. Do all of Tilghman's licensees make the same quality of candles, irrespective of the crude material on which they operate?

A. No.

X Q. 29. State by name to whom you refer, in answer to re-direct interrogatory No. 27, as Tilghman's license's?

A. Proctor & Gamble, the Ohio Candle Company, or Woods & Company, and A. Gross & Co.

X Q. 30. Do not some of these parties purposely mix crude tallow with their pressed stock, in order to make a cheap candle suited to the Western market?

A. I have no doubt they do.

923 X Q. 31. Does not some portion of the product from your distilling apparatus have an odor of acroleine?

A. Yes.

X Q. 32. Is not this odor practically removed by the subsequent ordinary treatment of washing, boiling, and pressing?

A. We don't wash or boil, and I do not think it is practically removed by pressing. I am not positive that the odor of which we are speaking should properly be called the odor of acroleine. To me it is more of a smoky smell than the sharp, pungent smell that I attach to acroleine.

X Q. 33. Does the bad smell, whatever it is called, of your distilled products, disappear or change in the subsequent handling, so as not to be objectionable in your finished candle?

A. We never have the candles objected to on account of smell, or the thing brought to our notice, even. The sharp acrid smell which we notice in our distillations is lost by evaporation or simple exposure to air, or by subsequent handling—or nearly removed thereby, leaving the smell like the samples produced to-day.

X Q. 34. From your visit to Ropes' factory, in Cincinnati, can you say whether his product has the sharp smell spoken of, or any smell resembling acroleine?

A. It had not.

X Q. 35. Had his product any more smell than Mr. Mitchell's?

A. It had not.

C. H. GRANT.

Subscribed and sworn to before me this 9th day of September, 1871.

R. E. STILWELL,
Examiner, Etc.

924 HENRY BOWER, being called and duly sworn as a witness on part of defendant, deposes and says:

Q. 1. Are you the same person who has heretofore been examined on the part of this defendant, in a suit brought by Mr. Tilghman for an infringement of his patent of 1854?

A. I am.

Q. 2. Are you largely engaged in the purification of glycerine; and, if so, how long have you been engaged in such business?

A. I am engaged in the purification of glycerine as largely as any one in the country, I suppose, and have been refining it since 1858.

Q. 3. Do you buy large quantities of impure glycerine for purification?

A. I do.

Q. 4. According to what qualities do you judge of it in purchasing?

A. According to its density and purity.

Q. 5. Have you bought of the defendant in this suit, glycerine for purification, and also bought glycerine for such purpose of other manufacturers?

A. I have.

Q. 6. The other manufacturers from whom you have bought glycerine, were they, or any of them working in their decomposition of fats under licenses from the complainant Tilghman, or using processes which were claimed by Tilghman to be an infringement of his patent?

A. I have bought glycerine from four parties directly. To the best of my knowledge they were licensees—M. Werk & Co., Cincinnati; Proctor & Gamble, same place; Goodwin, Behr & Co., St. Louis; and A. Gross & Co., Jersey City.

Q. 7. What was the relative purity of the glycerine obtained from the defendant and those other parties named, and if that obtained from such other parties was less pure than that obtained of the defend-
925 ant, how much less price did you give for glycerine of the same density as that obtained of the defendant?

A. I have always, in making bids for crude glycerine, given that made by R. G. Mitchell & Co. the preference to an extent running from 25 to 33 per cent. above that furnished by others.

Q. 8. Did you know of, in 1867, the persons who were engaged in the manufacture of fat acids in Philadelphia, or the State of Pennsylvania; and, if so, how many persons were engaged in such manufacture there, and who were they?

A. I only knew of one—C. H. Grant.

Q. 9. In the process then used by C. H. Grant was the glycerine saved or destroyed?

A. Destroyed.

Q. 10. In 1867 how many persons or parties east of Cincinnati were engaged in the decomposition of fats into fat acids and glycerine, or a solution of glycerine, and who were they, and where did they do business?

(Mr. Tilghman asks counsel for defendant to what portion of the case this testimony applies.

Mr. Law answers as before, in the examination of of C. H. Grant.

Mr. Tilghman objects, as before, in the testimony of C. H. Grant.)

A. There was only one—R. G. Mitchell & Co., of New York; perhaps Gross & Co., of Jersey City.

Q. 11. Have you read the testimony of Nathaniel Ropes, taken in the former suit and contained in the printed record from page 7 to 21, defendant's record.

A. I have.

Q. 12. Why, in your opinion, did Mr. Ropes, as stated in that testimony, treat his solution of glycerine as a waste product, and throw it away?

(Objected to as incompetent.)

926 A. Evidently because it was too weak to be a desirable purchase by those people who were buying glycerine-water.

Q. 13. Do you know whether Mr. Ropes is now engaged in manufacturing fatty acids; and, if not, how long since he ceased such manufacture?

A. I believe him to be still in the business.

Q. 14. Did you ever know or hear of a paper published in Philadelphia, about 1867, called the Universe?

(Same objection.)

A. I did.

Q. 15. Do you know anything of the extent of circulation of such paper? Did you ever see it on file in any of the news-rooms or libraries of Philadelphia?

(Same objection.)

A. I have no accurate knowledge of the extent of its circulation, but think it must have been small, or else it would not have gone out of existence. I never have seen it on file.

Q. 16. Was that paper a daily or weekly, and was it a sectarian paper; and, if so, connected with what denomination?

A. It was a weekly paper, connected with the Roman Catholic denomination.

Cross-examined:

X Q. 17. As a purchaser and refiner of crude glycerine in Philadelphia in 1867, was it to your interest that its price should *should* be as low as possible?

A. It was.

X Q. 18. Were there at that time, in Philadelphia, parties who used crude glycerine for making printer's rollers?

A. There were none there, to my knowledge.

927 X Q. 19. Did any parties in Philadelphia at that time use any kind of glycerine for that purpose?

A. There was only one that I know of—I can't give his name.

X Q. 20. Was not glycerine used at that time in Philadelphia by soap-manufacturers and perfumers to a considerable extent?

A. As far as I know it was used only to a small extent.

HENRY BOWER.

Subscribed and sworn to before me this 9th day of September, 1871.

R. E. STILWELL,
Examiner, Etc.

Counsel for defendant puts in evidence a certified copy of the order made by the Patent Office, March 16, 1867, on the petition of the complainant, for the extension of his patent of January 9, 1854, and which is marked "Defendant's Exhibit No. 7, September 9, 1871, R. E. S., ex'r."

Also a certified copy of the file and contents in the matter of the application of said Tilghman for said extension, and which is marked "Defendant's Exhibit No. 8, Sept. 9, 1871, R. E. S., ex'r."

Also certified copy of certain papers on the part of R. G. Mitchell,

in opposition to said extension, which papers are copy of statement made December 2, 1867, by William McIntire, and submitted to the Commissioner of Patents. Copy notice of appearance of C. M.
928 Keller and S. D. Law in opposition to the application for such extension; copy telegram of C. M. Keller to Commissioner of Patents, as to such extension, dated November 30, 1867, and copy of letter of S. D. Law to Commissioner of Patents, dated December 17, 1867, enclosing testimony of Mitchell in opposition to such application, all which are marked "Defendant's Exhibit No. 9, September 9, 1871, R. E. S, ex'r."

Also certified copy of an entry from the book, containing a list of patents for the year 1867, of the extension of patent granted R. A. Tilghman, October 3, 1844, antedated January 9, 1854, which is marked "Defendant's Exhibit No. 10, Sept. 9, 1871, R. E. S., ex'r."

Complainant's counsel, Mr. Tilghman, objects to the introduction of all the foregoing Exhibits Nos. 7, 8, 9, and 10, as irrelevant and incompetent.

Adjourned to Wednesday, September 13, at 1 p. m.

NEW YORK, *Wednesday, September* 13, 1871.

Present, counsel as before.

EDWARD S. RENWICK, being duly sworn as a witness on the part of the defendant, deposes and says as follows:

Q. 1. What is your name, age, residence, and occupation?

A. Edward S. Renwick; 48 years old; reside at Milburn, N. J., and am occupied principally as expert in the trial of patent causes and in soliciting patents.

929 Q. 2. Are you acquainted with letters-patent No. 11766, granted to complainant, dated the 3d of October, 1854, for improvement in processes for purifying fatty bodies; and, if yea, state fully the kind of apparatus in which the process is described to be carried on, and at what temperatures the fatty bodies are to be decomposed.

A. I am acquainted with the contents of letters-patent No. 11766, referred to in the question, by having carefully examined a printed copy thereof. The kind of apparatus described therein in which the process is to be carried on, is one capable of sustaining a working pressure of 2,000 pounds to the square inch, and which should be proved up to a pressure of 10,000 pounds to the square inch before putting it into use, in order that the operator may be certain that the apparatus or vessel is capable of sustaining the high working pressure to which it may be subjected during the operation. The patent, when speaking of the vessel, speaks of it as any convenient vessel in which the emulsion or mixture of the water and fat can be heated to the melting-point of lead, until the operation is complete. Also, that it must be closed and of great strength, which he, in another part of his patent, indicates to be sufficient to withstand when tested a pressure of 10,000 pounds to the square inch. The above peculiarities of the vessel amount to general statements; when the patentee subsequently describes in detail the apparatus for performing the process, he describes it as consisting, in substance, of a coil of tubing of small diameter, namely, half an inch, capable of sustaining the great pressure required to prevent the water from escaping from the mixture in the form of steam, and also connected with a loaded valve, which, by permitting the escape of a portion of the contents, would prevent the vessel from being burst by the expansion of the contents, even though the vessel be in the

930 first place entirely full of the liquid mixture. The temperature at which the fatty bodies are to be decomposed is one at or about the melting-point of lead, which is above the temperature at which fats begin to decompose by heat alone, even in open vessels. The patentee in one place states that the change or decomposition takes place with some materials, such as palm-oil, at or below the melting-point of bismuth, (510° F.) It also gives the test of melting tin (440° F.) as the lowest temperature which the operator need take any note of, and the test of melted nitrate of potash (660° F.) as the highest temperature which the operator need take any note of. These tests, coupled with the absence of any statement that the process can be operated at a temperature as low as the melting-point of tin, with any fat matter, show that the temperature relied upon is one exceeding the melting-point of tin, (440° F.) and not exceeding the melting-point of nitrate of potash, (660° F.,) the temperature of the melting-point of lead (612° F.) being the temperature for general practice,

Q. 3. Do you find in that patent any statement or intimation that, by reason of the presence of water, the patentee had discovered that fats could be decomposed at a temperature below that at which fats are decomposed by heat alone?

A. I do not.

Q. 4. What thickness of metal would be required to sustain the pressure specified in the plaintiff's patent, for a vessel of about two feet in diameter inside, and of capacity to contain 1,200 gallons?

A. Assuming that the vessel was made of iron, of the thickness required for safety, and with the iron not subjected to a greater tensile strain than is desirable in practice, say from 10,000 to 12,000 pounds per square inch, the vessel would have to be from 10 to 12 inches in thickness in order that it might sustain, without risk or injury, the test strain of 10,000 pounds to the square inch, which is stated in the patent.

931 Q. 5. From your acquaintance with the state of the useful arts in the year 1854, do you know if there was then known any convenient vessels in which to heat liquids, that would with safety sustain the pressure named in the patent, other than a coil of pipes and the generator of Perkins' flash steam-apparatus?

A. I know of none others.

Q. 6. To sustain high pressures, must not the thickness of metal be increased in proportion to the increased diameter? Give your reasons for its being so.

A. The thickness of the metal of a vessel to sustain pressures, must be increased in proportion to the increase of diameter, because the greater the diameter the greater the surface upon which the pressure can act. For example, in a vessel of ten inches in diameter, the aggregate force which tends to burst the vessel is equal to the pressure per square inch multiplied by the number of inches of the diameter, or ten. If the diameter be doubled to twenty inches, the aggregate bursting-force is equal to the same pressure per square inch multiplied by the new number of inches of diameter, or twenty.

Q. 7. In one of your former answers you speak of the coil of tubing of small diameter, namely, half an inch. Is it half an inch of internal or external diameter, and what is the other diameter?

A. The diameter of half an inch is half an inch internal diameter, it being customary among engineers, when speaking of tubes and pipes, to designate them by the dimensions of the internal diameter. The external diameter mentioned in the patent for such tubes is one inch.

Q. 8. Prior to 1854, were there vessels known in which to heat liquids, with the vessel entirely full of the liquid, with provision for the expansion of the liquid, without escape under heat, so that steam should not form in the vessel; and, if yea, what were such means?

932 A. So far as my knowledge extends, prior to the date mentioned there were such vessels known, consisting of a coil of tubes in connection with a vessel fitted with a loaded piston, which would permit the liquid in the vessel to expand without danger of bursting it, and without steam being generated. I also recollect a description of another vessel, consisting of a tube connected with a bellows-formed vessel of flexible metal, heavily loaded, which tube and vessel were entirely filled with the liquid; the pressure was sufficiently great to prevent the formation of steam, and the expansibility of the flexible vessel permitted the liquid to expand by the action of heat, without risk of bursting the tube.

Q. 9. What, if any, provision is made in the plaintiff's patent, either for the circulation of the emulsion of fat and water, or for the circulation of the water through the fat?

A. There is no provision whatever made in the patent for what I understand to be circulation, which I understand to be the movement of one article around in a circuit, so that it passes, at least, twice through the same medium or article. The patent describes a pump for the purpose of forcing the intimate mechanical mixture of the fat and water once through the tubular vessel, the mixture being forced in at one end of the vessel, escaping at the other end, and never passing twice through any portion of the vessel. The patent does not describe any means whatever of producing a circulation of water through the fat, nor does the patent suggest such an operation.

Q. 10. Does the patent provide for making a thorough admixture of the fat and water, termed an emulsion, before it is introduced in the apparatus, and does it provide for maintaining this thorough admixture while it is subjected to heat in the apparatus?

A. It provides for both.

933 Q. 11. Have you visited the establishment of the defendant and seen his apparatus in operation for decomposing fats; and, if yea, state whether you found, while the fat was subjected to heat in that apparatus, the water and fat were maintained in a state of admixture; and, if not, by what mode of operation did the water act upon the fat?

A. I visited the establishment of defendant, and saw the apparatus in operation, which were there used for decomposing fats. I had portions of the contents drawn from different parts of each apparatus. I found that the water and fat were not maintained in a state of admixture, the fat, in one portion of the apparatus, being practically free of water, and the water in another part of the apparatus being practically free of fat. Each of the apparatuses which I saw consisted substantially of two cylindrical vessels, set upright, and one at a higher level than the other; the upper vessel was connected with the lower vessel by means of two pipes, of, I should estimate, about three inches in diameter, one pipe proceeding from the lower part of the upper vessel to the lower vessel, and the other pipe connecting the upper part of the upper vessel with the lower vessel. The lower vessel was set in a furnace so that it could be heated. There was a cock at the lower part of the upper vessel in the vicinity of the connecting pipe, and another cock at the upper part of the upper vessel. By withdrawing portions of the contents of the upper vessel at this point, I found that the lower part of the upper vessel did not contain fatty matter, or contained a mere trace of it in the mixture

of water and glycerine, which occupied that part of the vessel. I also found that the upper part of the upper vessel contained a mere trace of watery matter, the contents being practically fatty matter alone.

Adjourned to September 14, 1871, at 11 a. m.

934 THURSDAY, *Sept. 14th*, 1871.

Present, counsel as before.

Witness continues: These facts, taken in connection with my knowledge of the circulation of liquids effected by heat, satisfy me:

1st. That, in the defendant's apparatus, and in the process employed by him, there is no intimate mechanical mixture of the fat and water, as described as being made in the Tilghman patent, and as important to be maintained until the mixture escapes from the vessel in which it is heated; for if there were such an intimate mechanical mixture the fat would have been found intimately mixed with water in the sample which I caused to be withdrawn from the lower part of the upper vessel, and water would have been intimately mixed with the fat in the sample which I caused to be withdrawn from the upper part of the upper vessel.

2d. That, in the defendant's apparatus, the water circulated, passing down from the lower part of the upper vessel into the lower vessel, thence upward through the connecting pipe to the upper part of the upper vessel, from which part of the apparatus the water percolated downwards through the fatty matter in the upper vessel to the lower part of that vessel, whence it started to pass again through the same circuit. The circulation of the water in this manner through the apparatus, and through the fat contained in the upper vessel, is due to the facts that the contents of the upper vessel are cooler than those of the lower, the atter being set in a furnace, by means of which its contents are continually heated, while the upper vessel is exposed to the air, so that its contents are being continually cooled by the radiation of heat from the exposed surface of the vessel. Hence, as the liquid in the lower vessel is heated it becomes specifically lighter (by reason of its expan-
935 sion) than the water in the lower part of the upper vessel, consequently the heated particles rise through the connecting pipe to the upper part of the upper vessel, and the cooler, and consequently, heavier particles of the liquid in the lower part of the upper vessel descend to take the place of those which rise: so that there is a constant circulation of the water through the apparatus and through the fatty matter in the upper vessel, and by reason of such circulation the water is the means of applying heat to the fatty matter, and removing from it the glycerine as fast as the latter is produced.

Q. 12. Look at the description of the mode of charging defendant's apparatus, in the testimony of Jos. T. Verdin, in the former case, between these parties, in his answer to Direct Question 128, on pages 45 and 46 of defendant's printed proofs, and, assuming defendant's apparatus to be charged as therein described, state whether, in the working of the process, there can be at any time an intimate admixture of the fat and water.

A. I have examined the description referred to in the question. Under the circumstances therein mentioned there cannot, in my opinion, be at any time an intimate admixture of the fat and the water in the apparatus.

Q. 13. Is the mode of operation in the apparatus of defendant, substantially the same, or substantially different from the mode of operation described in the plaintiff's patent?

A. In my opinion, the mode of operation of the former is substantially different from the latter.

Q. 14. Assume an apparatus to consist of a horizontal digester, with a horizontal shaft extending through it, having radial arms projecting from it, and so arranged that its shaft and arms are rotated by means applied outside, and the vessel to be heated and filled, as described in complainant's patent, with the emulsion of fat and water; and
936 another apparatus to consist of a vertical cylindrical vessel to contain the emulsion of fat and water, and with its upper end open, and this to be placed in an outer surrounding vessel, entirely closed, and this apparatus to have connected with it a pump, the induction end of which opens into the lower end of the inner vessel, and its eduction end above the emulsion in the inner vessel, and this latter apparatus to be heated to a high temperature, and during the operation the pump to be kept in action, (for a more accurate description of the latter apparatus, I refer you to the testimony of Florence Verdin, defendant's proofs before the master, in a former case between these parties, answer to the 18th interrogatory-in-chief;) and state how the mode of operation in each of these apparatuses corresponds with the mode of operation which you have already described as taking place in defendant's apparatus, and with the mode of operation, according to the plaintiff's patent.

(Objected to as irrelevant.)

A. With the apparatus first described the intimate mixture or emulsion of the fat and water would be maintained as long as it remained under treatment by the continuous agitation produced by the revolution of the arms, and the fat and water would be heated simultaneously in intimate admixture and under the pressure and temperature, substantially as described in the Tilghman patent. The mode of operation would be substantially the same as described in the patent, and substantially different from the mode of operation which takes place with the defendant's apparatus.

In the latter case, as I understand the construction of the apparatus and the mode in which it is used, the fat and water would, in my opinion, separate from each other, the fat occupying the upper portion
937 of the inner vessel and the water occupying the lower portion of that vessel. The effect of the pump would be to withdraw continuously a portion of the water from the lower part of the inner vessel, and to eject it into the upper part thereof above the fat.

The water so injected would penetrate down through the fat and collect in the lower portion of the inner vessel, beneath the fat, whence it would in turn be again withdrawn to go through again the same circuit. The heated water would thus circulate through the apparatus and through the fatty matter, while the fatty matter would remain in the upper portion of the inner vessel. The heat in this case would be applied both to the fat and to the water. In the respect that in this apparatus the admixture of the fatty matter and water is not maintained during the operation, and that the water is caused to circulate through the fat, the mode of operation is substantially different from that described in the Tilghman patent, and is substantially like that which takes place with the defendant's apparatus.

The mode of applying heat to the fatty matter is different, in one respect, from that used with the defendant's apparatus, because in the latter the fatty matter is heated only by the hot water circulating through it, while in the apparatus last described in the question the fatty matter is heated in part by the hot water in circulating through

it and in part by the steam enveloping the upper portion of the inner vessel in which the fatty matter is contained.

Adjourned to 11 a. m., September 15, 1871.

FRIDAY, *September* 15, 1871.

Present, counsel as before.

Witness continues: As, however, the fatty matter is heated by the operation of the hot water percolating through it, I consider
938 that this part of the operation is not materially different from the mode of operation employed in decomposing fats with the defendant's apparatus.

Q. 15. In the application of R. A. Tilghman for his patent, granted October 3, 1854, and to which your attention has been called, he states in his letter to the Commissioner of Patents, accompanying his application, that a patent for Great Britain had been granted to him for the same invention on the 9th day of January, 1854, to which last-mentioned date his United States patent was antedated. Please examine the English patent so granted to said Tilghman, January 9, 1854, and state what is the temperature required by that patent for decomposing fats into fat acids and glycerine, and the reasons for your opinion.

(Complainant's counsel objects to all parts of the testimony of this witness which refer to his construction of the specification of complainant's patent, because that is a matter of law for the court, not within the province of an expert.)

A. I have examined a copy of the specification of the English patent referred to in the question. The temperature required by that patent for decomposing the fatty matter into the fat acids and glycerine, is at or about the melting-point of lead, not being less than the melting-point of tin (440° F.,) and not exceeding the melting-point of nitrate of potash (660° F.) My reasons for this opinion are that the English specification states that the vessel to be used is one in which the mixture of fatty matter and water "can be subjected to the action of heat to a temperature about the same as that of melting lead, until the operation is completed." This general statement is qualified somewhat by a subsequent statement that the change (i. e. the decomposition) with
939 some fatty matters takes place "at or below the melting-point of bismuth," (510° F.,) but the patent subsequently states that even with such materials "the heat has been carried considerably above the melting-point of lead, without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased." The patent also gives a series of thermometric indications by means of which the temperature of the apparatus may be indicated to the operator. The lowest one of these is the melting-point of tin, (440° F.,) which is evidence to my mind that it was the intention of the patentee that the working-temperature should never be lower than the melting-point of tin. This conclusion is placed beyond any doubt by the language of the second part of the English specification, in which the patentee states as follows: "The degree of heat is less than that which is necessary to produce free fat acids, and should generally be kept between the melting-points of tin and bismuth," that is, between 440° F. and 510° F. My reason for stating that the highest temperature was not to exceed the melting-point of nitrate of potash is, that the patent gives that point as the highest thermometric indication of which the operator need take note.

Q. 16. Please examine in the paper now shown you, being a certified

copy of the file and contents in the matter of the patent granted to the complainant by the United States, October 3, 1854, the copy specification set forth in such paper, and originally filed by said Tilghman in his application for said patent, and state what is the temperature set forth in, and required by, that specification for decomposing fats into fat acids and glycerine, and the reasons for your opinion?

(Same objection as before.)

940 A. The temperature required for the purpose is at or about the melting-point of lead, being not less than the melting-point of tin (440° F.,) and not exceeding the melting-point of nitrate of potash (660° F.) My reasons for this opinion are, that the copy specification set forth in the paper now shown me, appears to be identical in language with the English specification referred to in the last question and answer, so far as respects the entire descriptive portion of it, and it contains the same statements as I have referred to in my answer to the previous question. My reasons, therefore, are the same as are given in my answer to the previous question.

(The paper shown witness is put in evidence by defendant's counsel, and the same is marked "Defendant's Exhibit No. 11, September 15, 1871, R. E. S., ex'r.")

Q. 17. Does the specification of complainant's patent indicate to your mind the discovery on which the process described therein is based; and, if so, what is such discovery? And give your reasons for any opinion which you may express.

(Same objection as before.)

A. It does indicate to my mind such a discovery, viz, the discovery that fatty matter could be decomposed into fatty acids and glycerine at the temperature at which it could be decomposed in open vessels, and even at a higher temperature, with great quickness and perfection, and without apparent injury, provided it be maintained during the operation in intimate mixture with water, and under a pressure sufficient to prevent the water from escaping from that mixture in the form of steam.

Q. 18. And what is the heat and pressure, and the conditions deemed necessary, as stated in the patent? And state also the length of time in which the decomposition would be effected, in view of the discovery stated in your last answer.

(Same objection as before.)

941 A. The heat deemed necessary is at or about the melting-point of lead, (612° F.,) not less than the melting-point of tin, (440° F.,) and not exceeding the melting-point of nitrate of potash, (660° F.) The pressure deemed necessary is one which may rise as high as a working-pressure of 2,000 pounds to the square inch, and not less than one which will prevent water from escaping in the form of steam at the temperature of melting tin, which would be about a pressure of 345 pounds above the atmosphere. The conditions deemed necessary, in addition to the prescribed heat and pressure, are that the fatty matter and water shall be intimately mixed before they are subjected to the heat and pressure, and shall be maintained "in the same state of intimate mixture" during the entire operation. The length of time in which the decomposition would be effected, according to the patent, is very short, the longest time that is deemed expedient being ten minutes.

Cross-examined:

X Q. 19. When did you take the specimens from defendants' apparatus, as stated in your eleventh answer, and who were present?

A. I think on or about the 4th day of the present September. The persons who were present were Mr. R. G. Mitchell, the defendant; his son, Henry P. Mitchell; and the operative who had charge of the apparatuses. His name I do not know.

X Q. 20. From how many apparatuses did you take specimens?

A. In the first place I had specimens taken from one apparatus. I subsequently had specimens taken from the whole six apparatuses that were in use. The specimens in the last instance, taken from the lowest stop-cock of each upper vessel, being all drawn into one small vessel, and the specimens from the upper stop-cock of each upper vessel being all drawn into another small vessel.

942 X Q. 21. What was the pressure in said apparatuses at the time?

A. My recollection is that the pressure was about 12 atmospheres above the atmospheric pressure, or about one hundred and eighty pounds to the square inch.

X Q. 22. For how many hours had each apparatus been in operation at the moment when you took these specimens?

A. I do not know of my own knowledge. I understood the operator to say that he had had on the pressure since 5 o'clock in the morning, in which case each apparatus had been in operation about nine and a half to ten hours when I had the samples drawn.

X Q. 23. Did you ever see samples taken after the apparatus had been only one or two hours in operation?

A. I never did.

X Q. 24. What was the appearance of the specimens of the water? Was it clear or milky?

A. They were not clear, but could hardly be said to be milky. They had the appearance of what is commonly called slightly turbid water, or opalescent.

E. S. RENWICK.

Subscribed and sworn to before me this 15th day of September, 1871.

R. E. STILWELL,
Examiner, Etc.

THURSDAY, *Sept. 14th*, 1871.

Present, counsel as before.

CHARLES F. CHANDLER, being sworn as a witness on the part of the defendant, deposes and says as follows:

Q. 1. What is your name, age, residence, and occupation?

943 A. Charles F. Chandler; age, 34; reside at 70 E. 49th street, New York; occupation, chemist—professor of analytical and applied chemistry in the school of mines at Columbia College; professor of chemistry in the New York College of Pharmacy; chemist to the department of health of the city of New York; consulting chemist to several manufacturing companies.

Q. 2. State what is the specific gravity of melted fat, in the aggregate, as compared with the specific gravity of water, both being at the same temperature.

A. The specific gravity of melted fat varies from 90 to 92 hundredths of water of the same temperature, or about nine-tenths.

Q. 3. Will heat without the presence of water or steam decompose fats; and, if yea, at what temperature?

A. Heat decomposes fat in the absence of water or steam at a temperature of about 600° F., varying, perhaps, from a little above 500 degrees up with different fats.

Q. 4. What chemical effect in the decomposition of fats will the presence of water or steam exert?

A. The presence of water secures the hydration of the constituents of the fat, so that they appear as fatty acids and glycerine.

Q. 5. Will there be any difference in the chemical effect and the chemical result whether the decomposition takes place in the presence of water or of steam; and, if not, why not?

A. There will not be any difference either in effect or result, as the hydration of the constituents of the fat is effected with equal facility by both water and steam.

Q. 6. Does the vaporization of water effect any change in its constituents?

A. It does not.

944 Q. 7. Will glycerine without the application of high temperatures undergo decomposition so as to develop acroleine on standing, even for several years?

A. It will not. Its permanency is such that it is recommended as a superior material for lubricating delicate machinery, such as clock-work, and also for floating compasses.

Q. 8. What would be the effect in such uses of glycerine if it was tinctured with acroleine?

A. Acroleine undergoes oxidation to a greater or less degree when exposed to the air, changing to acrylic acid, which would be liable to cause a corrosion of metals to which it might be applied.

Q. 9. What is the proportion and quantity of lime required to completely saponify fat with water, so as to produce a solution of glycerine?

A. Nine and one-half per cent. of pure lime is required when the combination is perfect.

Cross-examined:

X Q. 10. Referring to your answer to Question 3-in-chief, state what are the products formed when fats are decomposed by heat alone, in the absence of water or steam.

A. Free fatty acids, together with several products of decomposition derived from the glyceryl which would form glycerine, were water present to hydrate it, and in part from portions of the fatty acids. This destruction is due to the fact that the water necessary to hydrate the fatty acid which is formed is abstracted from the glyceryl and from portions of the acid itself.

X Q. 11. I understand you to say that when fats are decomposed by heat alone, in the absence of water or steam, no solution of glycerine is formed. Is that so?

A. It is; as glycerine can only be produced from the fat by the combination of water with the glyceryl, and under the action of heat,
945 in the absence of water, this glyceryl, instead of taking water and forming glycerine, gives the elements of water to hydrate the fatty acids, and becomes acroleine.

X Q. 12. When fats are decomposed by heat alone, in the absence of water or steam, what becomes of the fat acid which is formed—does it remain in the vessel in which the fat is heated, or does it distill over in the form of vapor along with the vapor of acroleine?

A. The decomposition of fat by heat, in the absence of water or

steam, takes place at a temperature which, under the ordinary atmospheric pressure, is sufficient to distill off gradually the products of decomposition, and the fatty acids, acroleine, etc., pass over together in the state of vapor.

X Q. 13. Did you ever treat the fat by heat in the presence of steam so as to produce fat acids and solution of glycerine?

A. Never did.

X Q. 14. Do you know what is the proportional quantity of lime employed in practical manufacture of fat acid to completely saponify the fat?

A. All the way from one-half per cent. to fourteen, according to the operation and quality of lime.

X Q. 15. Where have you seen the manufacture of fat acid and glycerine practically carried on?

A. I have seen the manufacture of fat acids practically carried on in New Bedford; the manufacture of glycerine I have never seen, except as a laboratory operation, by the use of oxide of lead with fat.

X Q. 16. Was the New Bedford process, to which you allude, the distillation process?

A. It was not.

X Q. 17. How much lime was used there?

A. I have no recollection; it was many years ago I visited the establishment.

X Q. 18. When is 14 per cent. of lime used to saponify the fat in practical manufacture?

946 A. The figure 14 I obtain from the testimony of C. T. Jones, one of the witnesses for the plaintiff in this case, and to my recollection he does not specify the details of his process.

X Q. 19. When is ½ per cent. of lime used, as stated by you in your 14th cross-answer?

A. When the operation is conducted under pressure.

X Q. 20. Where did you get that information?

A. From the testimony of the same witness.

X Q. 21. Do you refer to the printed testimony of C. T. Jones in the suit of Tilghman v. Mitchell?

A. I do.

X Q. 22. Did you ever know the manufacture of fat acids to be practically carried on by the use of heat alone, in the absence of steam or water?

A. No; the products of the decomposition to which I have already alluded would make such a process impractical.

X Q. 23. Have you ever witnessed the operation of making fat acids and glycerine by the action of water and heat?

A. I have not, though I have suits of specimens illustrating the process, including the materials and products. As the operation takes place in a closed vessel, there is very little else to be witnessed.

X Q. 24. Where did you get your specimens?

A. From the factory of R. G. Mitchell.

X Q. 25. Did you ever see the practical operation of making these?

A. I did not.

X Q. 26. Did you ever see fat treated in the presence of steam, so as to make fat acid and glycerine?

A. I never did.

Redirect:

Re-D. Q. 27. Is it necessary for a chemist to witness the treat-

947 ment of fat by heat in the presence of steam to enable him to form a correct opinion as to whether the chemical action and result would be the same as by the treatment of fat by heat in the presence of water?

(Objected to by complainant's counsel.)

A. It is not.

Re-D. Q. 28. Have you witnessed the working of all chemical processes, as to the chemical actions and results of which you could form a correct opinion?

(Same objection.)

A. I have not; in fact, a great many of them take place in furnaces, so that it is impossible to witness the operation, and the effect could only be studied by means of the materials and products in connection with general chemical principles and experience.

Recross:

Re-X Q. 29. When and how did you first become acquainted with the fact that fat could be decomposed into fat acid and glycerine by heat and water alone?

A. I can't state with certainty; but I attended lectures in Berlin in 1855 on technical chemistry, and have been in the habit of lecturing on the subject ever since, consulting the best authorities, and reading the chemical journals. I presume, therefore, I became familiar with the fact as soon as it became public.

Re-X Q. 30. Do you know when, where, and by whom it was first made known to you?

A. I have already stated in my last answer.

Re-X Q. 31. Is that all the answer you can give to my question?

A. It is.

948 Redirect:

Re-D. Q. 32. Look at Ex. No. 10 of defendant's printed proofs in the former case between these parties, which is an article taken from the Journal for Practical Chemistry, Leipsic, 1850, article entitled "Upon the application of the superheated vapor of water," by Prof. E. S. Scharling, page 376, and what is in that article taught to the chemical world as to the decomposition of fats?

(Objected to as new matter and incompetent question.)

A. The experiments of Scharling teach the fact that the elements of water, acting on fat at a high temperature, decompose it with the production of free fatty acids.

Re-D. Q. 33. Let me call your attention to the following passage in the article referred to in the last preceding question, namely: "In all these distillations, not even the slightest trace of acryl combinations were observed; neither did I find pyrelaic or sebacic acid in the over-distilled water;" and state what that passage, in connection with the entire article, indicates to the chemist?

(Same objection.)

A. It indicates that the decomposition of the fats, under the circumstances described, was accompanied by the complete hydration of the acid and basic constituents of the fat, yielding fatty acids and glycerine, unaccompanied by acroleine or any other products of the destructive distillation of fat.

Recross:

Re-X Q. 34. Was the process of Scharling a distillation process?

A. It was.

949 (Counsel for complainants withdraws the last question and requests the examination to be closed.)

Redirect:

Re-D. Q. 35. In the process described by Scharling, was it the water or the products of the decomposition that were distilled?

(Objected to as new matter, and incompetent.)

A. The products of the decomposition were distilled over, the decomposition having taken place in the vessel previous to distillation.

Re-D. Q. 36. Let me call your attention to the temperature at which the process was carried on, as stated in the article, and state whether at that temperature the products of the decomposition would be volatilized?

(Same objection.)

A. By themselves at that temperature they would not be volatilized, but the current of superheated steam carried them over mechanically.

C. F. CHANDLER.

Subscribed and sworn to before me, this 14th day of September, 1871.

R. E. STILWELL,
Examiner, etc.

FRIDAY, *Sept.* 15*th*, 1871.

Present, counsel as before.

FLORENCE VERDIN, being called and duly sworn as a witness on the part of the defendant, deposes and says:

950 Q. 1. What is your name, age, residence, and occupation?

A. My name is Florence Verdin; 56 years of age; residence, Rockland County, New York. I am a farmer.

Q. 2. Were you ever associated with the defendant in the present suit; and, if yea, in what business and for what length of time?

A. I have been associated with the defendant in the city of New York, from 1850 to 1868, in the manufacture of stearic acid and candles and glycerine.

Q. 3. Have you now any interest of any kind in the business of decomposing fats into fatty acids and glycerine?

A. None.

Q. 4. When you were associated with the defendant in the business to which you have referred, did you have charge of, and were you familiar with the apparatus employed in, his establishment for decomposing fats into fatty acids and glycerine, under the Wright & Fouché patent?

A. I had charge of the Wright & Fouché apparatus from the year 1860 up to 1868, and operated the same personally.

Q. 5. State whether you have at any time tested the condition of the fat and water in such apparatus at various stages, from the time of charging up to the time of the completion of the decomposition of the fat; and, if yea, how have you tested it, and what was the result, as to the condition of the materials contained in the apparatus, in the different parts of the apparatus?

A. I have tested the materials in the different parts of the apparatus, from the beginning of the operation to the end of the operation, every ten minutes during the process, and have found invariably that the upper part of the upper boiler contained the fat, and the lower part of
951 the upper boiler, within four inches below the line of the fat, contained the water during the operation.

Q. 6. In the defendant's apparatus, referred to by you in your answer, is there, during the process of decomposing the fat, any admixture or emulsion of the fat and water?

A. Not the least.

Q. 7. Will pure glycerine be decomposed so as to give out an odor of acroleine by standing any length of time, without the application of heat?

A. It will not. It requires a high heat to decompose it to produce the acroleine.

Q. 8. If the odor of acroleine impregnated the soap or the fatty acids, would it seriously impair their value, or not?

A. It would seriously impair their value.

Q. 9. Prior to the introduction of the Wright & Fouché apparatus at the defendant's works, had you ever seen a decomposition of fat effected by superheated steam in an open vessel? If so, state when and where, and the quantity of lime used, if any.

A. I have, in Cincinnati, in the factory of George Shillito. My brother conducted the business at that time. He made an operation in an ordinary tub or vat, with superheated steam and seven per cent. of lime, and produced a good decomposition and a perfect separation of the fat and glycerine.

Q. 10. You have stated in a former examination, on a reference to Master White in a suit between these same parties, that you had never seen any stirring or mixing apparatus resembling those now used by Tilghman's licensees in the manufacture of soap and candles or in the making of fatty acids and glycerine, prior to 1854. State whether any such apparatus could be practically used in the old lime saponification of fat; and, if not, why not?

952 A. I never saw any of those stirring or mixing apparatuses used, for they were inclosed in the boiler. I never saw any used previous to 1854, and, since that time, only in a closed boiler; such stirring apparatus could not be used—first, because it is not wanted *for* to mix the lime, water, and fat; and, second, when it should be used, to have any effect to help break up the lime-soap, the lime-soap becomes so hard as the saponification progresses that the apparatus would be stopped by the mass of lime-soap, which becomes as hard as a soft sand-stone or pumice-stone.

Cross-examined:

X Q. 11. Referring to your 4th answer, state what was the condition of the materials in the "four inches below the line of the fat," there mentioned?

A. The condition of the materials in the four inches below the line of the fat, within the first hour of the operation, after we had it up to the required pressure, was, that there was no change in the condition of the water with the exception of some impurities floating through it: and, after that, as the decomposition commenced, the water began to look slightly white, and the nearer we came to the completion of the decomposition the water took the appearance of milk and the fat appeared to be decomposed.

X Q. 12. Referring to your 9th answer, state what were the products of the operation on fat with seven per cent. of lime and superheated steam in an open tub?

A. It was lime-soap and free fatty acids and glycerine, of course.

X Q. 13. What quantity or proportion of free fat acids were present in said products?

A. I did not analyze the quantity or proportion, and I do not know.

X Q. 14. Can you swear that there was one per cent. of free fat acid present in said products?

A. I cannot swear to anything which I have not ascertained.

953 X Q. 15. Was that process of saponification of fat with seven per cent. of lime and superheated steam in an open vessel, employed as a manufacturing operation, and if so, for how long, and by whom?

A. I do not know whether it was employed as a manufacturing operation, but I was told by my brother that it doesn't take much longer time to perform the operation than it does in their closed tank.

(Complainants' counsel objects to hearsay portion of this answer.)

X Q. 16. Did not George Shillito, for several years after this experiment, use a closed tank with water at a high temperature and pressure, and about six or seven per cent. of lime, to decompose the fat in his regular manufacture?

A. I think he did; but I don't know what percentage of lime he used; I know he use' the closed tank and superheated steam.

F. VERDIN.

Subscribed and sworn to before me this 15th day of September, 1871.

R. E. STILWELL, *Examiner*, &c.

ROLAND G. MITCHELL, the defendant, being called and duly sworn as a witness on part of the defendant, deposes and says:

Q. 1. Have you ever had any conversation with the complainant in this suit relative to the method of manufacture in decomposing fats at the works of Price & Co., in London; and, if so, when, and what was such conversation?

A. After the extraordinary testimony given by complainant in 954 the original suit and found on the printed record from pages 103 to 106, in which Mr. Tilghman testifies that he was several years in London, after 1854, during which he visited the manufactory of Price & Co., in London, and had not personally inspected their mode of working, and did not know how they worked, I asked him the reason for the want of such knowledge. He stated in reply that Mr. Wilson, who was the managing director of that company, was trying to invent a process of his own and would not allow him to inspect it, but, owing to an accident which prevented the working of that process, he (Mr. Tilghman) was called to their assistance. He then found that they had put a copper cylinder into an iron boiler. The copper cylinder leaked, allowing the fatty acids to come in contact with the iron, which discolored them. They took out the copper cylinder, and lined the iron boiler with lead, which they sustained in its place by hoops of copper, made from the defective cylinder. From the letter of Wilson to Tilghman, dated July 13, 1865, found on page 328 of the printed testimony in the case of Tilghman v. Werk et al., it appears there was a stirrer in the vessel, "but plainly insufficient for the proper contact of the water with the fatty body." No reference to this letter of Wilson's to Tilghman was made in that conversation, it having been written after such conversation took place.

R. G. MITCHELL.

Subscribed and sworn to before me this 15th day of September, 1871.

R. E. STILWELL, *Examiner*, &c.

Defendant's counsel states that, under the order of the court and the agreement of the complainant's and defendant's solicitors, there
955 are remaining to the defendant two more days in which to put in testimony in this case; but defendant, not desiring to examine more witnesses here in this city, requests complainant and his counsel to permit defendant to occupy such remaining time in taking testimony at Cincinnati, at such time within the next two weeks as may be convenient to the counsel for complainant, and complainant to have same length of time thereafter to reply.

Defendant's Exhibit No. 1.—*Sept.* 7, 1871.—*R. E. S., ex'r.*

WASHINGTON CITY, D. C., *November* 23, 1867.

C. M. KELLER, Esq., 37 *Park Row.*

DEAR SIR: Your letter of yesterday to hand. I found it necessary to call upon Judge Fisher and ask for postponement in the matter, Brown v. Dutton, interference. He granted me, for you, the postponement, to first Wednesday in January, 1868, upon condition that you would notify Dutton. I have also ordered copies of all papers in the application of Richard A. Tilghman, for extension of his patent of January 9, 1854, "purifying fatty bodies," except two books, (exhibits,) one quite large octavo, five or six hundred pages, and the other small. Thinking it probable that you can obtain the books very much cheaper, I enclose herewith a memoranda of the books, and await a reply, as to whether I shall order them from office.

Very respectfully,

W'M C. McINTIRE.

956 *Defendant's Exhibit No.* 2.—*Sept.* 7, 1871.—*R. E. S., ex'r.*

WASHINGTON CITY, D. C., *November* 29, 1867.

S. D. LAW, Esq., 25 *Pine street, N. Y.*

DEAR SIR: Your favor of the 27th to hand yesterday. The office being closed, I could not attend to the matter until this morning, when I discovered that the examiner had reported favorably, and Commissioner had extended patent. I therefore telegraphed you to save time.

Very respectfully,

W'M C. McINTIRE,
P. O. Box, 381.

In matter of Rich'd A. Tilghman, "Purifying fatty bodies."

Defendant's Exhibit No. 3.—*Sept.* 7, 1871.—*R. E. S., ex'r.*

Blank No. 1.

THE WESTERN UNION TELEGRAPH COMPANY.

The rules of this company require that all messages received for transmission, shall be written on the message-blanks of the company, under and subject to the conditions printed thereon, which conditions have been agreed to by the sender of the following message.

2 WILLIAM ORTON, *Pres't.*

O. H. PALMER, *Sec'y.*

Dated WASHINGTON, D. C., *Nov.* 29, 1867.
Received at 134 Pearl, Nov. 29.

To S. D. LAW, 25 *Pine:*

Tilghman's extension was granted Saturday last, twenty-third (23d.)

WM C. McINTIRE.

8—N. Y., 40.—Collect.

957 *Defendant's Exhibit No. 4.—Sept. 7, 1871.—R. E. S., ex'r.*

Blank No. 1. [0421

THE WESTERN UNION TELEGRAPH COMPANY.

The rules of this company require that all messages received for transmission shall be written on the message-blanks of the company, under and subject to the conditions printed thereon, which conditions have been agreed to by the sender of the following message.

5 p. m. WILLIAM ORTON, *Pres't.*

O. H. PALMER, *Sec'y.*

Dated WASHINGTON, D. C., 29, 1867.
Received at 145 Broadway, Nov. 29.

To S. D. LAW, Esq., 25 Pine st.

Patent not actually gone out of office, but will in day or two (2,)

WM. C. McINTIRE.

13—N. Y., 52. Collect.

Defendant's Exhibit No. 5.—Sept. 7, 1871.—R. E. S., ex'r.

25 PINE ST., NEW YORK, *Nov.* 19, 1867.

Patent of Richard A. Tilghman, dated Jan'y 4, 1854. Process for purifying fatty bodies.

SIR: Please inform me whether any application for an extension of the above-named patent has been made. And, if so, when the hearing is set down for, and when objections, if any are made, are to be filed, etc.

Please inform me as to the above on the receipt of this.

Yours, etc.,

S. D. LAW.

COM. OF PATENTS,
Washington, D. C.

958 (Answered in pencil as follows:)

App. for ext'n filed March 16, '67. Hearing June 17, '67. Probably extended.

A. M.

(On the back:) "Patent. Nov. 21, 1867. Office."

Defendant's Exhibit No. 6.—Sept. 9, 1871.—R. E. S., ex'r.

Specimens of candles referred to by the witness Grant, interrogatory 15, page 14.

Defendant's Exhibit No. 7.—Sept. 9, 1871.—R. E. S., ex'r.

The U. States Patent-Office to all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the files of this office.

In testimony whereof I, A. M. Stout, Acting Commissioner of Patents, have caused the seal of the Patent-Office to be hereunto affixed, this seventeenth day of January, in the year of our Lord one thousand eight hundred and sixty-eight, and of the Independence of the United State' the ninety-second.

{ SEAL OF U. S. PATENT-OFFICE. }

A. M. STOUT.

959

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT-OFFICE,
Washington, March 16th, 1867.

On the petition of Richard A. Tilghman, of Philadelphia, Pa., praying for the extension of a patent granted to him the 3d day of October, 1854, and antedated January 9th, 1854, for an improvement in process for purifying fatty bodies, for seven years from the expiration of said patent, which takes place on the 9th day of January, 1868:

It is ordered that the said petition be heard at the Patent-Office, on Monday, the 17th day of June next, at 12 o'clock m.; and all persons are notified to appear and show cause, if any they have, why said petition ought not to be granted.

Persons opposing the extension are required to file, in the Patent-Office, their objections, specially set forth in writing, at least twenty days before the day of hearing. All testimony filed by either party, to be used at the said hearing, must be taken and transmitted in accordance with the rules of the office, which will be furnished on application.

Depositions and other papers, relied upon as testimony, must be filed in the office twenty days before the day of hearing; the arguments, if any, within ten days after filing the testimony.

Ordered, also, that this notice be published in the Republican, and the Intelligencer, Washington, D. C., and in the Universe, Philadelphia, Pa., once a week for three successive weeks; the first of said publications to be at least sixty days previous to the day of hearing.

T. C. THEAKER,
Commissioner of Patents.

P. S.—Editors of the above papers will please copy, and send their bills to the Patent-Office, with a paper containing this notice.

960 *Defendant's Exhibit No. 8.—Sept. 9, 1871.—R. E. S., ex'r.*

The U. S. Patent-Office to all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the files of this office of the file and contents in the matter of the application for extension of the letters-patent, granted Richard A. Tilghman, dated October 3, 1854, and antedated January 9, 1854, No. 6801, for "process for purifying fatty bodies."

In testimony whereof I, M. D. Leggett, Commissioner of Patents, have caused the seal of the Patent-Office to be hereunto affixed, this sixth day of September, in the year of our Lord one thousand eight hundred

{ SEAL OF U. S. PATENT-OFFICE. }

and seventy-one, and of the Independence of the United States the ninety-sixth.

M. D. LEGGETT,
Commissioner.

PHILADELPHIA, *March* 15, 1867.

Hon. T. C. THEAKER.

SIR: Enclosed please find the application of Richard Tilghman for extension of patent, with a certificate of deposit of fifty dollars, the amount of first fee; also a power constituting me his attorney in his application.

Yours, respectfully,

GEORGE HARDING,
Per G. B.

961 To the Hon. T. C. THEAKER,
Commissioner of Patents:

The petition of Richard A. Tilghman, of the city of Philadelphia, respectfully represents:

That your petitioner was the inventor of a certain new and useful improvement in process for purifying fatty bodies, for which letters-patent of the United States, dated October 3, 1854, No. 11766 were granted to him for fourteen years from the 9th day of January, 1854.

That the said improvement has been and is now extensively used, and has been of great value to the public; and that, without neglect or default on the part of your petitioner, he has failed to realize from the use and sale of the invention remuneration for the time, ingenuity, and expense bestowed on the production of the invention and the introduction of it into public use. Your petitioner, therefore, prays that the said letters-patent may be extended for the further term of seven years, your petitioner having paid into the Treasury of the United States fifty dollars, and complied with the other provisions of the acts of Congress in such case made and provided.

Your petitioner hereby appoints George Harding, of Philadelphia, his attorney; authorizing him to correspond with the Patent-Office, and take all needful steps in the prosecution of this application.

R. A. TILGHMAN.

[50 c'ts. R. A. T. Mar. 15, 1867. 50 c'ts.]

CITY OF PHILADELPHIA,
State of Pennsylvania:

PHILADELPHIA, *March* 15, 1867.

962 Richard A. Tilghman, being duly sworn, doth depose and say the statements contained in the foregoing petition are true.

W. W. DOUGHERTY,
Alderman.

[5 c'ts. R. A. T. Mar. 15, 1867. 5 c'ts.]

(On the back:) Mar. 16, 1867.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT-OFFICE,
Washington, March 16, 1867.

On the petition of Richard A. Tilghman, of Philadelphia, Pa., praying for the extension of a patent granted to him October 3, 1854, ante-

dated January 9, 1854, for an improvement in process for purifying fatty bodies, for seven years from the expiration of said patent, which takes place on the 9th day of January, 1868:

It is ordered that the said petition be heard at the Patent-Office on Monday, the 17th day of June next, at 12 o'clock m.; and all persons are notified to appear and show cause, if any they have, why said petition ought not to be granted.

Persons opposing the extension are required to file, in the Patent-Office, their objections, specially set forth in writing, at least twenty days before the day of hearing. All testimony filed by either party, to be used at the said hearing, must be taken and transmitted in accordance with the rules or the office, which will be furnished on application.

Depositions, and other papers relied upon as testimony, must be filed in the office twenty days before the day of hearing; the arguments, if any, within ten days after filing the testimony.

Ordered, also, that this notice be published in the Republican
963 and the Intelligencer, Washington, D. C., and in the Universe, Philadelphia, Pa., once a week for three successive weeks; the first of said publications to be at least sixty days previous to the day of hearing.

T. C. THEAKER,
Commissioner of Patents.

P. S.—Editors of the above papers will please copy, and send their bills to the Patent-Office, with a paper containing this notice.

PHILADELPHIA, *April* 11, 1867.

Hon. T. C. THEAKER,
Commissioner of Patents.

SIR: I have transmitted the statement and account of R. A. Tilghman in his application for an extension of letters-patent for purification of fatty bodies, together with exhibits in the case, by to-day's mail.

Very respectfully, your obedient servant,
GEORGE HARDING.

(On the back:) April 12, 1867.

In the matter of the petition of Richard A. Tilghman for an extension of his patent for an improvement in process for purifying fatty bodies, dated October 3d, 1854, No. 11766, and expiring Jan. 9, 1868.

STATEMENT OF THE PETITIONER.

This invention is the application to practice of a chemical discovery made by the patentee, that water at a high temperature
964 and pressure has the power of converting fatty bodies into fat acids and solution of glycerine.

The novelty and originality of the invention have been most thoroughly investigated in the course of two suits at law brought by the patentee, and the result will appear from the following extracts from the opinions of the court:

In the case of Tilghman vs. Werk, argued in the circuit court of U. S., at Cincinnati, Nov., 1860, before Judges McLean and Leavitt, Judge Leavitt, delivering the opinion of the court, says:

* * * * * * *

It is obvious that in all the descriptions of these processes they are

essentially different from the plaintiff's invention, by whose apparatus free fat acid is produced solely by the chemical action of water at a high temperature under pressure.

It is certainly true that some of the discoveries referred to, especially Milly and Motard, and Dunn, approached very nearly to the discovery of the plaintiff, but as certainly stopped short of the object. They failed to reach the important chemical truth that highly-heated water under pressure will produce from fatty bodies free fat acid and solution of glycerine, without any other agency.

This view is most convincingly exhibited by the testimony of the experts who have been examined as witnesses. It is also sustained by the Commissioner of Patents, who, in his note to the defendant Werk of June 26th, 1858, rejecting his first application for want of novelty, distinctly informs him that Mr. Tilghman is the acknowledged discoverer of this process.

I have no hesitation in concluding that the attempt to invadidate the plaintiff's patent for want of originality in his invention has wholly failed.

The following is the note of the Commissioner of Patents, above referred to, which was one of the exhibits in the case:

965 U. S. PATENT OFFICE, *July 26th*, 1858.

SIR: Your application for a patent for an improved treatment of fatty acids has been examined. You are referred to Regnault's Chemistry, vol. 2, paragraph 1594; to Payne's Chemie Industrielle, p. 771; and to the patents of R. A. Tilghman, January, 1855, and October, 1854. Mr. T. is the acknowledged discoverer of this process. The application is refused for want of novelty.

Respectfully yours, etc.,

J. HOLT, *Commissioner.*

M. WERK, Esq.,
(Care of Munn & Co.,) New York.

In the case of Tilghman vs. Mitchell, argued July, 1864, in the circuit court U. S. for New York, Judge Nelson, delivering the opinion of the court, says:

* * * * * *

Previous to the date of this invention there were but two modes known, or in practical use, for decomposing fatty substances, and obtaining from them fatty acids and glycerine—one called the lime-saponification process; the other known as the distillation process. It is not material to give a particular description of these modes of separating the fatty acids and glycerine; it is sufficient to say that they were different from the patentee's in the process or mode of producing the result, much more expensive and tedious, and have generally gone out of use both in this country and in England since the complainant's improvement has become generally known and practiced.

We have looked through the proofs in the case with some care, and, without going into them in this opinion, are satisfied that the
966 complainant was the first person that discovered the chemical fact, that fatty or oily substances could be decomposed, and the fatty acids and glycerine separated by the action of water at a high temperature and under pressure. The jury of the chemical section of the Paris Exposition of 1855, of which Dumas, Graham, Persoz, and Kuhlman, were members, and Stas, reporter, acknowledged the priority

of the claims of the patentee to this invention, as will appear from the following extract from their official report, page 496:

"Saponification *agn*euse en vase clos. Les chemistes assimilent les matières grasses neutres aux éthers composés. Cette hypothèse a été émise, pour la première fois, par M. Chevreul, dans ses Recherches sur les corps gras."

"Comme les éthers se dédoublent quand on vient à les chauffer à une température elevé, en vase clos, avec de l'eau, on a été tout naturellement conduit à essayer d'effectuer ce dédoublement avec les corps gras neutres."

"L'expérience a confirmé cette prévision."

"C'est là, l'origine des nouveaux procédés de saponification que nous allons exposer en peu de mots."

"Ce fut M. Richard Albert Tilghman, chemiste de Philadelphia, qué imagina, le premier, d'appliquer, en grand, cette réaction."

"Dans une patente prise à Londres, de 25 mars, 1854,* il expose ainsi sa découverte, et sa manière d'opérer."

"Mon invention consiste dans une no'velle méthode pour obtenir des acides gras libres, et uue solution de glycérine, au moyen des corps gras ou huileux d'origine végétable ou animale, ayant le glycérine pour base."

"Mon invention consiste à exposer les graisses, ou les huiles
967 precitées à l'action de l'eau, à une haute température et pression, dont l'effet consiste á produire la combinaison de l'eau avec les éléments des graisses neutres, de façon à produire, en même temps, des acides gras libres, et une dissolution de glycérine."

* * * * * * * *

In the London exhibition of 1862, the claims of the patentee as the original inventor of the *agn*eous saponification process were also recognized and a medal was awarded him, which is submitted herewith.

(Reports of juries, exhibition of 1862, Class IV., Sec. A., pp. 3 and 7.)

The journal of the Society of Arts, London, Jan. 25th, 1856, pp. 148, 150, contains a lecture by G. F. Wilson, F. R. S., managing director of Price's Patent Candle Company, in which the invention is thus spoken of:

In January, 1854, Mr. Tilghman, an American chemist, who has studied all that has been published here and in France, on the subject of acidification and distillation of fatty bodies, obtained a patent for exposing fats and oils to the action of water at a high temperature, and under great pressure, in order to cause the combination of the water with the elements of the neutral fats, so as to produce at the same time free fat acids and solution of glycerine. He proposed to effect this by pumping a mixture of fat and water, by means of a force-pump, through a coil of pipe heated to about 612 Fahrenheit, kept under a pressure of about 2,000 pounds to the square inch, and, he states, that the vessel must be closed, so that the requisite amount of pressure may be applied to prevent the conversion of water into steam. This is, all must admit,
a beautiful, original chemical idea, well carried out. It has yet to
968 be proved how far it can compete successfully with distillation. We have made an arrangement with Mr. Tilghman which will give us the means of testing its commercial merits.

The value of the invention consists in the saving of the large quantity of sulphuric acid and lime formerly employed in the manufacture of fat acids, and in the production of the glycerine in a purer and more concentrated form.

*Should be 9 Jan y, 1854.

By the old process 14 pounds of lime and 28 pounds of sulphuric acid were necessary to convert 100 pounds of fat into fat acids, and the solution of glycerine produced was so dilute and impure that it would not repay the cost of purification, and in practice was thrown away.

By the patent process, as now generally worked, only half a pound of lime and one pound of sulphuric acid are used for each 100 pounds of fat, and the solution of glycerine is of 5° to 6° Beaumè in density and is now all utilized.

The money value of the articles saved, viz., 13½ lbs. of lime at ⅓ cent per lb., 27 lbs. sulphuric acid at 4½ cents per lb., and 8 lbs. glycerine at 8 cents per lb., amount to $1.89½ for each 100 pounds fat treated.

By the old process a large quantity of sulphate of lime was produced, in a thick, sludgy condition, which contained a considerable quantity of fat acid, and required to be repeatedly and laboriously washed to get it out, and retained some even when thrown away.

Owing to this loss, 100 lbs. tallow, or lard stearine, yielded in practice only 95 lbs. fat acids.

By the patent process only $\frac{1}{25}$ as much sulphate of lime is produced, which is in such distinct crystals that it retains no appreciable quantity of fat acids, requires no washing, and the yield of fat acids is 97 lbs. from 100 lbs fat.

969 This is a saving of 2 lbs. fat acids, worth 12 cents per lb., or 24 cents for each 100 lbs. fat treated, making in all $2.13½ saved for each 100 lbs. fat worked by the patent process.

A considerable economy of fuel and labor is also obtained by the patent process, and the decomposition is much more certain and uniform than by the old process.

The practical introduction of pure glycerine on the large scale into pharmacy and the arts may be said to have dated from this patent.

Richardson & Watts. Chemical Technology, London, 1863, vol. 1, part 3, p. 751:

"The only perfectly unobjectionable mode of obtaining glycerine, inasmuch as it alone insures the entire absence of mineral impurities, is the decomposition of fats by vapor of water at a high temperature. This mode of decomposition was first adopted as a means of obtaining fatty acids and glycerine by Mr. Tilghman in 1854."

Dr. Hartshorne, Monograph on Glycerine, Phila., 1865, p. 9: Gay-Lussac and Chevreul patented a process for separating the fatty acids, in 1825, but glycerine was hardly known in commerce, in its pure state, until the beautiful discovery and invention of Mr. Richard Albert Tilghman, of Philadelphia, patented in 1854, by which it was found to be obtainable absolutely pure by a very simple process.

Testimony of Henry Bower, defendant's expert, Tilghman v. Mitchell.
(Defendant's paper-book, p. 172.)

MAY 6, 1864.

Present, counsel for respective parties.

HENRY BOWER, sworn on part of the defendant, says:

970 I reside in Philadelphia.

Q. 1. What is your occupation or business?

A. I am a manufacturing chemist.

Q. 2. How long have you been such?

A. About seven years.

Q. 3. State whether, in your business, you purchase and purify glycerine for sale when purified?

A. I do.

Q. 4. Extensively, or otherwise?

A. Extensively.

Q. 5. Do you know whether there is in the United States any person who deals more largely than you in that article?

A. I do not know of any other person.

* * * * * * * *

X Q. 35. Since the introduction of glycerine by Price & Co., to what extent has its use increased compared with what it was before their introduction?

A. It has increased very much.

X Q. 36. Do you not believe that one hundred bottles of it are now used where one was used before Price & Co. introduced it?

A. I think it very probable.

* * * * * * * *

X Q. 45. From whom have you ever obtained a supply of crude glycerine in Philadelphia?

A. From C. H. Grant & Co.

X Q. 46. For how long a time and in what quantity did you so obtain it for manufacture?

A. I think a year or more. Large quantities.

X Q. 47. Do you know how Grant & Co. obtained such glycerine as they sold you?

A. By decomposing the fat in a boiler which was under pressure, and with an agitator running through the boiler. There was water also in the boiler.

X Q. 48. Did you not understand that Grant & Co. were working under Mr. Tilghman's license?

971 (Objected to by defendant's counsel as calling for hearsay.)

A. Yes, sir; I understood they were working under Mr. Tilghman's license.

X Q. 49. Did you not meet Mr. Tilghman at their works?

(Objected to.)

A. I did.

X Q. 50. In what year was this?

A. In 1859 or 1860, I think.

X Q. 51. Was not that the first glycerine that you worked on a large scale?

A. It was the first I worked on a large scale.

X Q. 52. Were you not the first manufacturer of pure glycerine on a large scale in the United States?

A. I believe I was.

X Q. 53. Do you make good glycerine from the crude glycerine you obtained at Grant's?

A. Very good.

* * * * * * * *

The manufacture of fat acids by the patent process is now being carried on in eight factories in the United States, at the rate of about seventeen millions of pounds of fat decomposed per year, on which the whole of the above saving is realized, amounting to $362,950.00 per annum.

In addition to this, about six and a half millions of pounds of fat are

worked, in four or five factories, by a combination of the old and the patent process, whereby one-half of the above saving is effected, amounting to $69,550.00 per annum, making the total saving to the country $432,500.00 per annum in the present actual condition of the manufacture.

972 There are also five factories in the United States working about twelve millions of pounds of fat by what is called the distillation process, which uses but a small quantity of sulphuric acid (6 per cent.) but involves a waste of about twenty per cent. of the fatty matter treated, and all the glycerine.

There can be but little doubt that eventually the last two classes of manufacturers will be compelled to adopt the patent process or leave the trade to those working more economically.

In this case there will be a further saving on these 18½ millions of pounds of about $309,000.00 per annum, making the total saving $741,000.00.

The account herewith submitted shows that, up to the present date, 20½ millions of pounds of fat have been manufactured by licensees using the patent process exclusively, and it is known that about ten millions of pounds more have been treated by Mr. Mitchell against whom suit is still pending.

Also 45¾ millions of pounds have been manufactured by licensees using the combined process. The total saving on these quantities amounts to $925,693.00 actually realized to the community.

The following is the history of the progress of the invention in the United States:

In September, 1858, the patentee returned from Europe, where he had been engaged nearly five years introducing the process.

He immediately had an apparatus made and put up at his own expense (about $1,400) at the factory of C. H. Grant & Co., Philadelphia, where it was successfully worked, and was purchased by the manufacturer in July, 1859.

Another apparatus, costing about $1,500, was immediately ordered, and was put up about December, 1859, by the patentee, at his own expense, at the factory of N. Ropes & Co., Cincinnati, by whom it was purchased and worked.

973 At that time nearly all the manufacturers in the West had adopted a modification or combination of the patent process with the old lime-saponification process; that is, they used 7 lbs. lime to 100 lbs. fat, together with water heated in a close vessel, under pressure, and produced a mixture of lime-soap, and free fat acids, which required but 14 lbs. of sulphuric acid to decompose it. They thus realized a saving of one-half of the lime and acid formerly employed.

These manufacturers were found to be very obstinate in their opinion that this process was entirely distinct from that of the patentee, and also that the quantity of lime could not be reduced below 7 lbs. to 100 lbs. fat with any good result.

Notwithstanding the demonstration afforded them by the practical working of the two apparatuses in Philadelphia and Cincinnati, they all refused either to pay for the portion of acid they already saved or to save the remainder by adopting the patent process to the full extent.

Suit was therefore brought in the circuit court of the United States against Mr. Werk of Cincinnati, which was argued in 1860 before Judges McLean and Leavitt, and a decision was rendered in February, 1862, which settled that, as to the portion of fat acid not neutralized by the lime, the mixed process was an infringement of the patent.

The case was, however, still contested before the master, and was only concluded in April, 1865, by the defendant paying damage and taking a license.

In 1862 the patentee prevailed on another manufacturer in Cincinnati (Jones & Conahan) to allow him to put up, at his own risk and expense, an apparatus costing $8,000.

Owing to all the machine-shops being fully occupied with contracts on war-vessels, this apparatus was about a year in construction, and was brought into successful use in July, 1863, and was purchased
974 by the manufacturers, and has been constantly in use up to the present time.

In April, 1862, a suit was commenced in the circuit court United States for New York against R. G. Mitchell, who was manufacturing fat acids by means of a French apparatus, (Wright & Fouché's patent,) in which a particular method of heating and mixing the fat and water in a close vessel was employed.

This case was argued before Judge Nelson in July, 1864; and, in November, 1864, a decree was rendered sustaining the plaintiff's patent, and deciding that the defendant's operations were an infringement thereof.

This case is still pending before the master upon the question of amount of damages.

Copies of the record, testimony, and opinion of the court in these two cases are herewith submitted.

Shortly after the decision of Judge Nelson most of the manufacturers took licenses and paid for their previous partial use of the patent process.

In 1865 another Cincinnati firm (Proctor & Gamble) had an apparatus made in Philadelphia, under the directions of the patentee, and started into use under his personal superintendence.

In 1866 a fourth apparatus was made in Philadelphia, and started in Cincinnati, by the patentee, for W. H. Woods & Co., who had previously been using the distillation process.

In January, 1867, another apparatus, made in Philadelphia, was started in Louisville, K'y, by Cornwall & Bro., who had hitherto been using the distillation process.

Mr. Gross, of New York, has had one made in Philadelphia, and expects to start it in April or May, 1867.

Goodwin & Behr, of St. Louis, expect to start one about the same time.

Proctor & Gamble, of Cincinnati, having had one in use two
975 years, have ordered another, which is now nearly finished, at the machine-shop of Merrick & Sons, Philadelphia.

The rate of license charged by the patentee has been twenty cents per hundred pounds of fat decomposed without any lime or with only one-half per cent. of lime, and ten cents per hundred pounds of fat decomposed with seven per cent. of lime, being in each case less than one-tenth of the total saving.

An examination of the accounts herewith submitted will show that, up to December 31, 1864, the patentee had expended, in introducing his invention into use and in vindicating his legal rights therein, the sum of $18,314.46, and had received $17,833.08, leaving a loss of $481.38, besides his time and labor for six years.

In the year 1865, for the first time, the patent began to be profitable, and he has received up to this date, April 11, 1867, thirty-three thou-

sand one hundred and sixty-five $\frac{78}{100}$ dollars ($33,165.78,) net profit for his time and labor for eight and a half years.

It is probable that this sum will be increased to thirty-eight or thirty-nine thousand dollars up to January 9, 1868, the date of the expiration of his patent.

R. A. TILGHMAN.

STATE OF PENNSYLVANIA,
City and County of Philadelphia, ss:

This 11th day of April, A. D. 1867, before me the subscriber, one of the aldermen and ex-officio justice of the peace in and for said county, personally appeared the above-named Richard A. Tilghman, and made solemn oath that the foregoing statement is true; and, further, that the annexed printed papers [are] true copies of the opinions of the court in the cases of Richard A. Tilghman vs. Michael Werk, and Richard A. Tilghman vs. Roland G. Mitchell, respectively.

W. W. DOUGHERTY,
Alderman.

[5. R. A. T., 1867. 5 G. B. P.]

976,977 *An account of all moneys expended and received by Richard A. Tilghman, on account of this patent for an improvement in processes for purifying fatty bodies, dated Oct. 3, 1854, No. 11766, and expiring Jan. 9, 1868.*

	Expenses.			Receipts.	
1853.			1859.		
Nov.	Paid for experimental apparatus	$198 77	Sept.	Received cash from C. H. Grant & Co., Philadelphia, in payment for copper digester put up at their factory	$1,360 65
1854.					
March.	" patent fee and expenses	40 00			
1858.					
Aug.	" travelling expenses to Cincinnati	75 00			
1859.					
May.	Copper-digester, put up at factory of C. H. Grant	1,360 65			
Nov.	Copper digester, put up at factory of N. Ropes, Cin	1,527 67			
"	Experimental apparatus	400 40			
Dec.	Retaining fees of counsel, G. Harding and H. Stanbery, esqs., in case Tilghman v. Werk	200 00			
Dec. 5	Expenses at Cincinnati, putting up digester at factory of N. Ropes, and taking testimony, T. vs. Werk	353 00			
	Total expenses up to Dec. 31, 1859	$4,155 19		Total receipts up to Dec. 31, 1859	$1,360 65
	Loss by patent up to Dec. 31, 1859 $2,794.54		1860.		
1860.			Feb. 17	Grant & Co. license on lbs. 463,850	927 70
June.	Fees of experts in Tilghman v. Werk, for analysis, experiments, &c., Prof. J. Booth	300 00	Aug. 9	Grant & Co., " " 349,635	699 27
	Prof. R. E. Rogers	150 00	Aug. 6	Ropes & Co., " " 270,050	540 10
	Prof. F. A. Genth	450 00			
July.					
Oct. 19	Travelling expenses, Tilghman v. Werk	25 00			
	Expenses at Cincinnati, argument, Tilghman v. Werk	538 65			
	Printing " "	114 00			
	Telegraphing " "	79 63			
	Copies from Patent Office " "	18 00			
Dec. 18	Lithographing " "	13 97			
	Fee to H. Stanbery, esq., argument " "	500 00			
	Total expenses up to Dec. 31, 1860	$6,344 44	1861.	Total receipts up to Dec. 31, 1860	$3,527 72
1861.	Loss by patent up to Dec. 31, 1860 $2,816.72		Jan. 17	Grant & Co., license on lbs. 402,800	805 60
			Dec 16	Ropes & Co., " " 300,000	600 00
	Total expenses up to Dec. 31, 1861	$6,344 44		Total receipts up to Dec. 31, 1861	$4,933 32
	Loss by patent up to Dec. 31, 1861 $1,411.12		1862.		
1862.			Jan. 27	Ropes & Co., license on lbs. 297,000	594 00
Feb.	Expenses of sending specimens to London exhibition, and of medal obtained	148 00	Feb. 24	Ropes & Co., payment for copper digester	1,527 67
Mar. 17	Expenses at Cincinnati, Tilghman v. Werk	225 00	" 10	Grant & Co., licence on lbs. 150,000	300 00
" 14	Printing opinion of court, "	18 00	May 19	" " 125,860	251 72
April 22	Bradley & Wells, Cincin., printing, "	17 00			
May 14	Retaining fees to counsel, Tilghman v. Mitchell	300 00			

May 31	G. Harding, esq., professional services, T. v. Werk		1,116 00
July 30	Morris & Towne, iron plates for digester		365 24
	Total expenses up to Dec. 31, 1862		$8,533 68
	Loss by patent up to Dec. 31, 1862	$926.97	
1863.			
Feb. 2	Dutton, commissioner, Tilghman v. Mitchell		37 50
" 11	Curtis, " "		30 00
" 7	Straguickey, translator, "		12 25
" 14	Apparatus for experts "		164 52
M'ch 10	Morris & Tasker, tubes and brass work, digester		800 06
April 1	Giffard's injector "		65 25
May 8	Two steam-gauges, "		77 00
July 9	J. Oat & Sons, copper-work, "		2,077 63
" 25	Morris & Towne, iron work, "		1,578 84
M'ch 26	Clark's fire-regulator, "		75 00
May 26	Gardom, paint, "		20 50
July 29	Travelling expenses to Cincinnati		50 00
"	Expenses at Cincin., starting digester, Jones & Conahan		258 65
	Total expenses up to Dec. 31, 1863		$13,780 88
	Loss by patent up to Dec. 31, 1863	$4,768.17	
978, 979			
1864.			
Feb. 2	Travelling expenses to Boston, T. v. Mitchell		$ 96 00
" 15	" Cincinnati, "		65 80
" 24	To M'ch 14, expenses at New York, "		439 00
April 2	K. G. White, commissioner, "		262 30
May 27	" " "		19 88
" 25	Duval, lithographing, "		38 75
" 24	Travelling expenses		31 83
June 14	" "		13 30
" 3	Ashmead, printing, Tilghman v. Mitchell		229 50
10	Aug. 2, Dec. 7, E. W. Stoughton, argument, Tilghman v Mitchell		1,500 00
" 11	Prof. Wolcott Gibbs, experts, Tilghman v. Mitchell		200 00
	" J. C. Booth, " "		500 00
	" F. A. Genth, " "		400 00
	" R. E. Rogers, " "		210 00
	" Bridges, " "		210 00
July 22	Travelling expenses to Windsor, Vt. "		190 00
Nov.	W. Harding, printing, "		118 75
Dec. 1	Travelling expenses, New York, "		6 12
	Telegraphing, "		2 35
	Total expenses up to December 31, 1864		$18,314 46
	Loss by patent up to Dec. 31, 1864	$481 34	
1865.			
Jan. 25	G. Harding, esq., prof. services, T. v. Mitchell		2,000 00
Feb.	And Oct., Fisher, esq., " T. v. Werk		335 00
Feb. 10	Nesbitt, printing, T. v. Mitchell		69 70
July.	Expenses at Cincinnati, starting digester for Proctor & Gamble		248 37

	Total receipts up to Dec. 31, 1862		$7,606 71
1863.			
Oct. 6	Ropes & Co., license on lbs. 703,000		1,406 00
	Total receipts up to Dec. 31, 1863		$9,012 71
1864.			
Feb. 15	Ropes & Co. license on lbs., 249,500		$499 00
M'ch 21	Jones & Conahan, " 480,000		960 00
"	" " 368,235		736 47
May 12	" " 423,265		846 53
July 16	" payment for digester		5,059 52
Oct. 24	" license on lbs., 170,695		341 39
Dec. 13	" " 188,730		377 46
	Total receipts up to Dec. 31, 1864		17,833 08
1865.			
Feb.	Ropes & Co., license on lbs., 333,000		666 00
" 14	Ohio Candle Co., " 493,955		987 91
April 12	" " 444,150		888 30
June 17	" " 181,650		363 30
June 17	" " 147,650		295 30

An account of all moneys expended and received by Richard A. Tilghman, on account of his patent for an improvement in processes for purifying fatty bodies, dated Oct. 3, 1854, No. 11766, and expiring Jan. 9, 1868—Continued.

	Expenses.			Receipts.		
Feb.	Expenses at Cincinnati, Master, T. v. Werk	200 00	Oct.	" " 295,615		591 23
Feb. 13	H. Stanbery, prof. services, "	200 00	Dec. 14	" " 332,890		665 78
Sept. 9	Iron plates for digester	978 47	M'ch 1	Proctor & Gamble, " 6,000,000		6,000 00
	G. Harding, prof. services, T. v. Werk	500 00	April 6	" iron plates for digester		978 47
	B. C. Tilghman, for services as agent, one-half of net profits, as per agreement	$21,726 33	June 29	" license on lbs., 263,950		527 90
			Sept. 4	" " 6,000,000		5,944 00
			Oct. 17	" " 365,780		731 56
			Dec. 19	" " 780,985		1,561 97
			July.	M. Werk & Co., " 14,000,000		14,000 00
			Sept. 21	N. Schaffer & Co., " 10,000,000		10,387 00
			April.	Goodwin, Behr & Co., " 960,000		960 00
			May 16	" " 148,000		148 00
			June 24	" " 132,000		132 00
			July 24	" " 147,000		147 00
			Sept. 4	" " 112,000		112 00
			Oct.	" " 252,000		252 00
			Nov. 6	" " 144,000		144 00
			Dec. 19	" " 144,000		144 00
			Aug. 1	Hill & Shillito, " 900,600		900 60
			Sept. 21	" " 907,160		907 16
	Total expenses up to Dec. 31, 1865	$14,557 28		Total receipts up to Dec. 31, 1865		66,268 56
				Profit by patent up to Dec. 31, 1865	$21,711.28	
980, 981						
1866.			1866.			
April.	Expenses at Cincinnati, starting digester, Woods & Co	$332 80	Feb. 3	Ohio Candle Company, license on lbs. 308,825		$617 65
	Travelling expenses, T. v. Mitchell	77 42	April 23	" " 374,430		748 86
	B. C. Tilghman, agent, one-half net profits	8,171 18		" " 111,000		222 00
				" " 66,070		132 14
			Oct. 3	" " 416,750		833 50
			Dec. 3	" " 392,435		784 87
			Oct. 18	Jones & Conahan, " 1,000,000		997 50
			Nov.	" " 1,000,000		997 50
			May.	Ropes & Co., " 360,000		720 00
			Feb. 7	Proctor & Gamble, " 549,640		1,099 28
			M'ch 9	" " 366,030		732 06
			April 12	" " 326,105		652 21
			May 7	" " 221,470		442 94
			July.	" " 743,965		1,487 93
			Aug.	" " 513,490		1,026 98
			Sept. 10	" " 330,220		660 44

			Dec. 7	"	"	506,385	1,012 77
			Jan. 30	Goodwin & Behr,	"	100,000	100 00
			M'ch 6	"	"	188,000	188 00
			May 2	"	"	316,000	316 00
			July 12	"	"	84,000	84 00
			Nov. 9	"	"	284,000	284 00
			Dec. 7	"	"	161,000	161 00
			May 15	Hill & Shillito,	"	927,630	927 63
			May.	Chas. Harkness,	"	3,022,600	1,511 30
			Sept. 6	"	"	23,160	11 58
	Total expenses up to Dec. 31, 1866	$53,138 46		Total receipts up to Dec. 31, 1866			$83,021 15
				Profit by patent up to Dec. 31, 1866		$29,882 47	
1867.	Travelling expenses, Tilghman v. Mitchell	$6 75	1867.				
	B. C. Tilghman, agent, one-half net profits	3,283 08	Jan. 14	Proctor & Gamble, license	on lbs.,	435,970	$871 94
			Feb. 9	Ohio Candle Company,	"	272,090	544 18
			Jan. 14	Goodwin & Behr,	"	160,000	160 00
			Feb. 13	"	"	124,000	124 00
			Jan. 4	Jones & Conahan,	"	1,600,000	997 50
			" 17	"	"	1,000,000	997 50
			Feb. 14	Woods & Co.,	"	252,110	504 22
			"	Proctor & Gamble,	"	532,535	1,065 07
			M'ch 15	Woods & Co.,	"	255,450	510 91
			"	Jones & Conahan,	"	641,600	641 60
			Omitted	in 1866, Schneider,	"	156,000	156 00
				Total quantity manufactured, lbs.		65,951,965	
				Total receipts up to April 11, 1867			$89,594 07
	Total expenses up to April 11, 1867	$56,428 29		Total profit from patent up to April 11, 1867		$33,165 78	

R. A. TILGHMAN. R. A. TILGHMAN.

STATE OF PENNSYLVANIA,

City and County of Philadelphia, ss :

Before me, the subscriber, one of the aldermen and ex-officio justice of the peace in and for said county, personally appeared the above-named Richard A. Tilghman, and made solemn oath that the foregoing is a full and true account of all moneys received and expended by him on account of his patent for an improvement in processes for purifying fatty bodies, dated Oct. 3, 1854, No. 11766.

Sworn to and subscribed this eleventh day of April, 1867.

W. W. DOUGHERTY,
Alderman.

Ex'd, A. T.
[5. 5. [R. A. T., 1867. 5. 5.]

982 PHILADELPHIA, *May* 2, 1867.

Hon. T. C. THEAKER,
Commissioner of Patents.

SIR: Enclosed please find affidavits in the matter of the application of R. A. Tilghman for an extension of letters-patent for improved mode of treating fatty bodies.

Very respectfully, your obedient servant.

GEORGE HARDING.

(On the back:) May 3, 1867.

In the matter of the application of Richard A. Tilghman for an extension of his patent for an improvement in processes for purifying fatty bodies, dated Oct. 3d, 1854, No. 11766, and expiring Jan. 9, 1868.

CITY OF PHILADELPHIA,
State of Pennsylvania, ss:

On this 27th day of April, 1867, before me, the subscriber, an alderman and ex-officio a justice of the peace in and for said city, personally appeared Robert E. Rogers, who, being duly sworn according to law, did depose as follows:

I am professor of chemistry in the medical department of the University of Pennsylvania, and have been so for the past fourteen years.

I was formerly professor of chemistry in the University of Virginia for nine or ten years, and was chemist to the geological surveys of Pennsylvania and New Jersey for several years.

I edited the American edition of Turner's Chemistry, and the Eng-
983 lish translation of Lehman's Physiological Chemistry. I have been acquainted with Richard A. Tilghman for the past twenty years.

I was called upon as an expert in the suits of Tilghman vs. Werk, in 1860, and Tilghman vs. Mitchell in 1864, and then made a careful investigation of the subject of the manufacture of fat acids and glycerine.

The chemical history of this manufacture happens to be very easy to trace, from the fact that it originated from the labors and discoveries of two of the most celebrated French chemists, Gay-Lussac and Chevreul, about the year 1825. Ever since that time researches, as to the nature and properties of fatty bodies, have been rather a favorite subject with chemists, and the results obtained, and the improvements in the art, consequent thereupon, are to be found recorded in the chemical journals and text-books.

In the suits above referred to, the scientific and technical history of the subject was throughly gone into, and numerous publications and patents, in England, France, and Germany, were referred to by the defendants, with a view to show a want of novelty in the plaintiff's invention.

This invention was the application to practice of an alleged new fact or chemical discovery, viz., that water, at a high temperature and pressure, had the power of decomposing neutral fats into fat acids and solution of glycerine, and the main question was, when and by whom was that fact first discovered and announced?

The result of my study of the books and documents cited, and my general knowledge of the subject, leave not the slightest doubt in my mind that Mr. Tilghman was the original discoverer of this fact, and that his patent was the first announcement of it to the public.

984 I have myself witnessed the working of the tubular apparatus, described in detail in Mr. Tilghman's patent, and found it to agree closely with his description.

I consider this discovery and invention to be meritorious and beautifu in a scientific point of view, as well as valuable and important in its practical application. A tedious, laborious, and expensive treatment of the raw material—first with alkali, and then with acid, is here replaced [by] a simple digestion with water, and the desired result is obtained in a most neat, quick, and economical manner.

I am not sufficiently acquainted with the statistics of the manufacture of fat acids in the United States to give an estimate of its extent, but I know that it is worked on a very large scale.

The saving of large quantities of sulphuric acid, has a national importance, even beyond its actual value, as we are dependant upon foreign countries for the supply of sulphur and nitrate of soda, from which it is made.

The glycerine produced in the manufacture of fat acids by the old process, was so impure that it was seldom considered worth saving, and was generally thrown away. The glycerine then found in commerce was made by a special and expensive process, and was supplied in very small quantities.

Since the introduction of Mr. Tilghman's process, all the glycerine produced in the manufacture of fat acids is utilized, and the supply of a pure article in large quantities, and at a comparatively low price, has caused its valuable properties to be generally recognized, and applied to a great variety of purposes, so that its consumption has increased, I should suppose, at least a hundred fold.

R. E. ROGERS.

Sworn and subscribed this 27th day of April, 1867, before me.

JOHN WHITE,
Alderman.

[5,5. G. W., April 27, 1867. 5,5]

985 In the matter of the application of Richard A. Tilghman for an extension of his patent for an improvement in processes for purifying fatty bodies, dated 3d Oct., 1854, No. 11766, and expiring January 9th, 1868.

STATE OF PENNSYLVANIA,
City and County of Philadelphia, ss:

On this 24th day of April, A. D. 1867, before me, the subscriber, one of the aldermen and ex-officio a justice of the peace in and for said county, personally appeared JAMES C. BOOTH, who, being duly sworn according to law, deposed as follows:

I am by profession an analytical chemist, and have been melter and refiner in the United States Mint, at Philadelphia, during the past fifteen years. I studied chemistry with Wöhler, in Cassel, Germany, and with Professor Magnus, in Berlin, during 1833, 1834, and 1835. From 1835 to the present time, I have been engaged as professional analytical chemist. I was professor of chemistry applied to the arts, in the Franklin Institute, Philadelphia, ten years, and professor of chemistry and physics in the Central High School, Philadelphia, about two years. I was engaged in manufacturing chemistry for three years. I am the author of the greater part of the Encyclopedia of Chemistry; also, of a report upon the progress of chemical manufactures, made to the

Smithsonian Institute, at the request of Professor Henry. I also edited the translation of Regnault's Chemistry. I have been well acquainted with Richard A. Tilghman for the past twenty-five years.

My attention was first drawn to his process of making fat acids and glycerine, by his mentioning to me some time in the fall of 1853,
986 that he had discovered a method of decomposing fats, so as to obtain the fat acids and glycerine in a separate state, without the use of acids, alkalies, or other chemicals, and that he was just on the point of going to Europe to take out patents for the process.

I remember telling him that I could not conceive how it could be done, unless, perhaps by electricity.

Shortly afterwards he went to Europe, and was there several years.

Since that time my attention has been more particularly called to the subject, by being examined as an expert in the suits of Tilghman vs. Werk, in 1860, and Tilghman vs. Mitchell, in 1864.

I then made a careful study of all the chemical works referred to by both parties in those suits, and also made many experiments with the process, and analysis of products, as will more fully appear by referring to my testimony in those causes.

My conclusion has been that Mr. Tilghman was undoubtedly the original discoverer of the chemical fact, that water, at a high temperature and pressure, had the power of decomposing fatty bodies into fat acids and glycerine. Up to the date of his patent there is no trace of the knowledge of this fact in any of the chemical treatises or in any of the numerous patents relating to the manufacture. After Mr. Tilghman's patent, every technical work on the subject, and many patents, both in Europe and the United States, refer to the new mode of decomposition.

I know that Mr. Tilghman has been at very great trouble and expense in introducing his process into use, and in prosecuting infringements.

The two cases above named were contested with the greatest energy; the whole history of the manufacture, from the time of its commencement by Gay-Lussac and Chevreul, was thoroughly investigated, to find mention of any previous use of the invention, but entirely without success.

987 There can be no doubt, in the mind of any chemist, that it was a new fact, discovered by the patentee.

I consider this invention of very great importance and value, as it not only saves the large quantities of sulphuric acid and lime, formerly used, but has been the means of practically introducing into the arts, for the first time as an article of commerce, on a large scale, a supply of pure glycerine, which has many valuable applications, and is greatly extending in use.

From the best statistical information I can obtain I think that, on an average, about twenty-five to thirty millions of pounds of fat are yearly manufactured into fat acid for candle-making in the United States, the saving on which, by Mr. Tilghman's process, as compared with that formerly used, I should estimate at about two cents per pound, amounting to five or six hundred thousand dollars per year.

JA'S C. BOOTH.

Sworn to and subscribed before me this 24th day of April, A. D. 1867.

H. TREMAINE, *Alderman.*

In the matter of the application of Richard A. Tilghman for an extension of his patent for an improvement in processes for purifying fatty bodies, dated 3d October, 1854, No. 11766, and expiring January 9, 1868.

STATE OF PENNSYLVANIA,
City and County of Philadelphia, ss:

On this 22d day of April, A. D. 1867, before me, the subscriber, one of the aldermen and *an* ex-officio a justice of the peace in and
988 for said county, personally appeared WILLIAM M. TILGHMAN, who, being duly sworn according to law, deposed as follows:

I am the brother of Richard A. Tilghman. I am not in any way pecuniarily interested in the patent above referred to. Since Mr. Tilghman's return from Europe, in 1858, I have been in the habit of seeing and conversing with him almost daily. I have been kept acquainted with the progress of his legal proceedings in relation to the patent, and also with the efforts he has made to introduce it into practice.

I know that since September, 1858, his time and attention have been mainly devoted to these two objects.

He has been frequently absent at the West, sometimes for several months together, superintending the putting up and working of apparatus, and, while in Philadelphia, was much engaged in attending to the construction of it.

W. M. TILGHMAN.

Sworn and subscribed this 22d day of April, 1867, before me.
W. W. DOUGHERTY, *Alderman.*

[5, 5. W. W. D., April, 22, 1867. 5, 5.]

CITY AND COUNTY OF PHILADELPHIA,
State of Pennsylvania, ss:

On this 30th day of April, 1867, before me, the subscriber, an alderman, and ex-officio justice of the peace in and for said county, personally appeared LEWIS LAWS, who, being duly sworn according to law, did depose as follows:

I am a member of the firm of J. P. Morris, Towne & Co., machinists, Port Richmond Iron-Works, Philadelphia.

989 I have been acquainted with Richard A. Tilghman for about eighteen years.

In September, 1862, we began to make for him an iron digester about 3 feet diameter, and 36 feet long. It was made in the strongest manner and was tested at the pressure of 450 lbs. per square inch. Owing to our being very fully occupied with contracts for Government work, it was some ten months in hand, and was finished in July, 1863.

It was lined with an interior copper vessel, and had a large gun metal pump arranged to be worked from the outside, and was altogether a peculiar and complicated piece of apparatus.

It was made entirely from Mr. Tilghman's plans and drawings, and its construction was superintended by him personally. It was sent to Cincinnati and was used there, as I am informed and believe, in the manufacture of fat acids and glycerine, by a patent process of Mr. Tilghman's. The bill for our work, exclusive of the iron plates, pump, etc., which were furnished by Mr. Tilghman, was $1,578.84, and was paid by Mr. Tilghman.

In December, 1864, we began, and in June, 1865, we completed for

Mr. Tilghman another digester of the same general character, but of larger diameter and less length, which was also sent to Cincinnati and used, as I believe, for the same purpose as the first. Our bill for this, exclusive of the iron plates, was $5,022.19, and was paid by Mr. Tilghman.

Since then we have made three other digesters for parties in Cincinnati, St. Louis, and Jersey City, of the same kind as the above, and fitted up in the same general way. All these five sets of apparatus were made entirely from plans furnished by Mr. Tilghman, and were tested by him before they were accepted and sent away.

Each one took several months to construct, during which time
990 Mr. Tilghman was in the habit of frequently visiting our factory and supervising the progress of the work. Mr. Tilghman also guaranteed to us, payment for the apparatus made for other parties under his directions.

LEWIS LAWS.

Sworn and subscribed this 30th day of April, 1867, before me.
JOHN CLOUDS, *Alderman.*

[5, 5. J. C., April 30, 1867. 5, 5.]

In the matter of the application of Richard A. Tilghman, for an extension of his patent for an improvement in processes for purifying fatty bodies, dated Oct. 3d, 1854, No. 11766, and expiring January 9th, 1868.

STATE OF PENNSYLVANIA,
City and County of Philadelphia, ss:

On this twenty-sixth day of April, A. D. 1867, before me, the subscriber, one of the aldermen and ex-officio a justice of the peace in and for said county, personally appeared GEO. R. OAT, who, being duly affirmed according to law, deposed as follows:

I am a member of the firm of Joseph Oat & Sons, coppersmiths, Quarry street, Philadelphia. I have been acquainted with Richard A. Tilghman about fifteen years. In July, 1859, we made for Mr. Tilghman a copper boiler or digester, about 3 feet in diameter, 13 feet long, and ⅜ inch thick, with a rotary stirrer or agitator, working through a stuffing-box. It was very strong, double riveted, and weighed about
3,000 lbs.; it was tested at 250 lbs. per square inch, by hydraulic
991 pressure. It was made entirely according to Mr. Tilghman's plans and under his personal superintendence, and was paid for by him, about $1,300.

It was put up at the factory of C. H. Grant & Co., Philadelphia, and was used by them for making fat acids and glycerine, as I understood, according to a process patented by Mr. Tilghman. About September, 1859, we made another similar copper digester, after Mr. Tilghman's drawing, for C. H. Grant & Co., which was paid for by them.

About October, 1859, we made another similar digester for Mr. Tilghman, which was paid for by him, and was sent to Cincinnati; its cost was about $1,400.

About October, 1862, we made for Mr. Tilghman another copper vessel, of a different kind, about 34 inches diameter and 36 feet long, which we put inside a very strong iron digester, made at Morris & Towne's factory, Philadelphia.

We fitted a pierced diaphra[g]m and large pipes to a gun-metal pump

in the copper vessel; it was a complicated piece of apparatus, and was made altogether from Mr. Tilghman's plans and drawings and under his personal superintendence.

My bill for the copper work was $2,077.63, and was paid by Mr. Tilghman. I understood that this apparatus was sent to Cincinnati and was used for manufacturing fat acids and glycerine, by a patent process of Mr. Tilghman's.

About December, 1864, we made another apparatus, about 48 inches diameter and 22 feet 10 inches long, on the same general plan; the drawings were furnished by Mr. Tilghman. My bill for this was $3,092.37, and was paid by Mr. Tilghman,

This apparatus was put inside an iron digester, made by Morris & Towne, and was sent to Cincinnati.

About August, 1865, we made another copper vessel, 46 inches
992 diameter and 28 feet long, of the same general character, after Mr. Tilghman's drawings, and put it in an iron digester, made by Morris & Towne; it was sent to Cincinnati.

About May, 1866, we began another similar copper vessel for Mr. Gross, of New York, according to Mr. Tilghman's directions. This, also, was put into an iron digester, made by Morris & Towne, and was sent to New York.

In July, 1866, we made another, of similar size and character, for Mr. Cornwall, of Louisville, Ky., which we put into an iron digester, made by Merrick & Sons, Philadelphia.

About the same time we made another, for Goodwin & Behr, St. Louis, and put it in a digester made by Morris & Towne.

In November, 1866, we made another, for Proctor & Gamble, Cincinnati, which we put in a digester, made by Merrick & Sons.

All the details of these various apparatus were made entirely according to the plans and under the personal inspection of Mr. Tilghman, and were tested by him before they were accepted. Each one occupied several months in construction, during which time Mr. Tilghman was in the habit of frequently visiting our factory and supervising the progress of the work.

Mr. Tilghman also guaranteed to us payment for all the apparatus made under his directions for the parties above named.

GEORGE R. OAT.

Sworn and subscribed, this 26th day of April, 1867, before me.

JOHN WHITE, *Alderman.*

[5 5 J. W. Ap'l 26, 1867. 5 5.]

(On the back:) Rec'd May 3, 1867.

993 EXAMINER'S ROOM, No. 2, U. S. PATENT OFFICE,
November 23d, 1867.

To the Commissioner of Patents:

I have the honor to submit the following report in the matter of the application of R. A. Tilghman, for extension of patent granted to him October 3, 1854, ante-dated January 9, 1854, for process of purifying fatty bodies.

The invention in this case consists in separating what are known as fat acids from glycerine, by treating animal and vegetable fats with water at a high temperature. The result is the production of a solution

of glycerine in water and solid fat acids, which may be used for the manufacture of candles and other purposes. The glycerine may also be concentrated and purified.

The novelty of the invention has been fully sustained by verdicts in two suits in the United States courts; also, by the scientific juries in the London International Exhibition of 1862, and in that of Paris of 1855.

The novelty of the invention is therefore not questioned. The utility of the invention is also fully shown by the testimony filed in the case. The value to the public is proved to be over one thousand dollars per day. The invention, though both novel and useful, did not yield any return worth mentioning until within the last two years of the period for which the patent was granted. The invention required a total change in the established process of decomposing fats for the manufacture of fat acids, and was therefore attended with considerable expenditure of money and time. As soon as the invention was well introduced infringers used it, so as to make it necessary to appeal to the courts for protection. This occasioned still further expenditure, which con-
994 sumed nearly all the profits derived from the patent up to within two years of the expiration of the patent.

Since that time the patent has yielded a fair return, but not sufficient to cover the previous twelve years, during which almost nothing was saved over and above the necessary expenditure.

There is no opposition to the extension of the patent, nor is it believed that the public interest would be affected injuriously by granting the extension.

The invention I regard as one of great value to the public, and believe that the petitioner has fully complied with all the conditions to entitle him to an extension of his patent. I therefore recommend the extension be granted as prayed for.

B. S. HEDRICK, *Examiner.*

(On the back:) Examiner's Report.

FILE WRAPPER.

Extension.

1867. Hedrick.

No. 6,801.
Richard A. Tilghman.
Of Philadelphia,
County of "
State of Penn.
Process for purifying fatty bodies.
Rec'd M'ch 16, 1867.
Petition " " "
Affidavit.
Specification.
Drawing.
Model old Pat. " 16, 1867.
1 Cert. Dep. $50, M'ch 16, 1867.
Cash.
Add'l fee cert.
" " cash.
995 Examined
2 Issue
3 Patented

Rec'd Ap'l 1, '67.

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Recorded vol. page
Circular,
Pat'd Oct. 3d, 1854. GEO. HARDING,
Ante-dated Jan'y 9, 1854, Phila.,
Hearing June 17, 1867. Pa.
W. B. T. Closing May 28, " 1867.

(On the back:) 1867. Patent extended Nov. 23d, 1867. T. C. Theaker, Comm. 1867.

Defendants' Exhibit No. 9. Sept. 9, 1871, R. E. S., Ex'r.

The U. S. Patent-Office to all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the files of this office of "certain papers, testimony, etc.," in the matter of the application for extension of the letters-patent granted R. A. Tilghman, dated Oct. 3d, 1854, and ante-dated Jan. 9th, 1854, No. 6801, for "process for purifying fatty bodies."

In testimony whereof I, M. D. Leggett, Commissioner of Patents, have caused the seal of the Patent-Office to be hereunto affixed this sixth day of September, in the year of our Lord one thousand eight hundred and seventy-one, and of the Independence of the United States the ninety-sixth.

SEAL OF U. S. PATENT-OFFICE.

M. D. LEGGETT,
Commissioner.

996 Statement made this 2d day of December, A. D. 1867, in the matter of the extension of Richard A. Tilghman's patent, Jan. 9, 1854.

On the 23d day of November, 1867, I received a letter, dated New York, November 22d, 1867, from Charles M. Keller, esq., desiring to know if any application had been made for an extension of a patent, granted January 9, 1854, to Richard A. Tilghman, for "purifying fatty bodies," and, if so, desiring me to order copies of all papers filed in the matter as soon as possible. On the said day, about 10 o'clock a. m., I went into the examiner's room (having charge of that class) and made inquiries, and was informed by the assistant examiner that he knew of no such case. I remarked that it was strange that Mr. Keller seemed to be under the impression that there might be an application, and I then left the room and went to see the clerk, in the draughtsman's room, having charge of all extension cases. He at once recollected the case, and told me it was with the examiner. I told him that the examiner thought different, whereupon he asked me to accompany him to the examiner's room, which I did. Upon entering the room I saw the principal examiner had returned, we walked to the desk and found the case. The examiner then asked me some questions, which I do not now recollect, and I told him I was about to order some copies of all the papers on file, and asked him if he thought it probable that I could get copies of two printed books (exhibits) outside of the office, and thus save Mr. Keller any unnecessary expense; he thought I might. I therefore ordered on that day, and immediately after leaving the room, copies of

all the papers except the exhibits. Said order is now on file in the office. I then wrote to Mr. Keller, informing him that the application had been made, and that I had ordered the copies, etc. I heard
997 nothing further in the matter until November 28, (Thanksgiving,) when I received a letter from Mr. S. D. Law, an attorney associated in this matter with Mr. Keller, inclosing a notice of appearance on the part of R. G. Mitchell in opposition. Said notice is now on file in the Patent-Office. When I received this notice I again called on the clerk in charge of extensions, in the draughtsman's room, and he informed me that the patent had been ordered extended. I looked at the file and said that such was the case; the report of the examiner and order of commissioner bearing date of Nov. 23d, 1867, the day upon which I ordered the copies. I immediately telegraphed Mr. S. D. Law, and he is now in Washington.

W'M C. McINTIRE.

(Endorsed:) No. 4. Statement by William C. McIntire in the matter of the extension of Rich'd A. Tilghman of his pat. of January 9, 1854. "Purifying fatty bodies."

Before the Commissioner of Patents.

In the matter of the application of Richard A. Tilghman for the extension of letters-patent granted October 3, 1854, (English patent dated January 9, 1854,) for "improvement in processes for purifying fatty bodies."

SIR: Please take notice that we have been employed by Roland G. Mitchell, of the city of New York, to oppose your application for an extension of the above patent.

998 You are therefore requested to give us notice of any further evidence you may take in the above application, and also to furnish us, on receipt of this, with a list of the names and residences of the witnesses, if any, whose testimony may have been previously taken.

Yours, &c.,

C. M. KELLER,
37 Park Row, N. Y.,
S. D. LAW,
25 Pine St., N. Y.,
Att'ys for R. G. Mitchell.

To RICHARD A. TILGHMAN.

(Endorsed:) Application of Richard A. Tilghman for extension of patent for purifying fatty bodies. Notice of opposition thereto by R. G. Mitchell. Received and filed Nov. 30, '67. No. 7. C. M. Keller and S. D. Law, New York, attorneys.

THE WESTERN UNION TELEGRAPH COMPANY.

O. H. PALMER, *Sec'y.* 4–11 a. m. WILLIAM ORTON, *Pres't.*

Dated New York, Nov. 30, 1867.

Received at Post-Office, Wash'n, D. C., Nov. 30.

To T. C. THEAKER,
Comm'r of Patents:

An extension was allowed last week of patent of R. A. Tilghman for "purifying fatty bodies." The patent, I believe, has not yet left

999 the office. The patent does not expire until January ninth (9) next. Please direct the patent to be retained until I can reach Washington, Tuesday morning next.

C. M. KELLER,
37 *Park Row.*

50 N. Y. 200 paid.

(Endorsed:) No. 9. L. . Telegraph dispatch from Keller. Nov. 30, '67.

25 PINE ST., NEW YORK, *Dec.* 17, 1867.

Application for the extension of patent, granted Oct. 3, 1854, to R. A. Tilghman—process for purifying fatty bodies.

SIR: Enclosed I send evidence in the above matter, on the part of R. G. Mitchell, the remonstrant against the said application of R. A. Tilghman, together with a stipulation that such testimony may be read and used in such hearing, the same as if taken directly in the above matter.

Other testimony on the part of said remonstrant will be forwarded to-day or to-morrow.

Yours, etc.,

S. D. LAW,
Att'y for R. G. Mitchell.

COMM'R OF PATENTS,
Washington, D. C.

1000 (On back, marked in lead pencil:) Patent Office, Dec. 18, 1867. Extension granted before these papers were received. F. C. S. Application for extension of R. A. Tilghman's patent of Oct. 4, 1854, for processes for purifying fatty bodies. Testimony on part of R. G. Mitchell, remonstrant. New York, 17 Dec. Free. Commissioner of Patents, Washington, D. C.

The U. S. Patent-Office to all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the files of this office.

In testimony whereof I, M. D. Leggett, Commissioner of Patents, have caused the seal of the Patent-Office to be hereunto affixed this ninth day of September, in the year of our Lord one thousand eight hundred and seventy-one, and of the Independence of the United States the ninety-sixth.

(SEAL OF U. S.)
(PATENT-OFFICE.)

M. D. LEGGETT,
Commissioner.

1001 Before the Commissioner of Patents.

In the matter of the application of Richard A. Tilghman for the extension of letters-patent granted to him October 3, 1854, (English patent dated January 9, 1854,) for improvements in processes for purifying fatty bodies.—Roland G. Mitchell, opposing, a contestant.

It is hereby consented and stipulated, on the part of the said applicant, that a copy of the testimony of Charles Taylor Jones, A. G. Cheever, George Shillito, and Michael Werk, taken in the city of Cincinnati, Ohio; on the 8th, 9th, and 10th days of May, 1867, before Hamilton M. Hincle, esq., a notary public, to be used on the part of the defendant in

a certain suit pending in the United States circuit court for the southern district of New York, wherein Richard A. Tilghman is the complainant, and Roland G. Mitchell is defendant, and in a reference in said suits now pending before Kenneth G. White, esq., a master of said court, may be filed by the contestant, Mitchell, in this proceeding, before the Commissioner of Patents, and that such copy-testimony may be read and used on the hearing of the said application, in the same manner and with the same effect as if taken, and said witnesses had been examined on the part of said contestant directly in this proceeding, subject to all legal exceptions as to the admissibility of the same and in reference thereto.

New York, December 11, 1867.

GEORGE HARDING,
Solicitor for Applicant,
Per B. C. TILGHMAN.
C. M. KELLER AND
S. D. LAW,
Solicitors for Opponent, R. G. Mitchell.

1002 SOUTHERN DISTRICT OF NEW YORK,
City of New York, ss:

Stephen D. Law, being duly sworn, deposes and says that he obtained from Kenneth G. White, the clerk of the United States circuit court for said district, in which the suits in which the testimony hereto annexed was taken, copies of the original depositions in said cause, made by the several parties whose names are mentioned in the foregoing stipulation, and that the annexed printed document, purporting to be copy of the testimony of such parties, was printed from the copies so obtained by deponent from said clerk.

S. D. LAW.

Subscribed and sworn to before me this 17th Dec., 1867.
KENNETH G. WHITE,
U. S. Commissioner.

Ex'd. E. M. H.

1003 *Defendant's Exhibit No.* 10.—*Sept.* 9, 1871, *R. E. S., Ex'r.*

The U. S. Patent-Office to all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy of an entry upon the book containing list of patents for 1867, being volume 2, "M to Z," of the extension of patent granted R. A. Tilghman, dated October 3d, 1854, and ante-dated January 9th, 1854, No. 6801, for "process for purifying fatty bodies."

In testimony whereof I, M. D. Leggett, Commissioner of Patents, have caused the seal of the Patent-Office to be hereunto affixed this eighth day of September, in the year of our Lord one thousand eight hundred and seventy-one, and of the Independence of the United States the ninety-sixth.

{ SEAL OF U. S. PATENT-OFFICE. }

M. D. LEGGETT,
Commissioner.

Alphabetical list of patentees for the year 1867.

No.	Patentee.	Invention or discovery.	Class.	Dr'g.	Spec'n.	To whom sent.	When sent.
	Tilghman, Richard A.	Process for purifying fatty bodies.	Extension.	Nov.	23	Delivered to A. M. Smith.	Dec. 14, 1867.

1004 *Defendant's Exhibit No.* 11.—*Sept.* 15, 1871, *R. E. S., Ex'r.*

The U. S. Patent-Office to all perons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the files of this office of the file and contents in the matter of the letters-patent granted Richard A. Tilghman, dated October 3, 1854, and ante-dated January 9, 1854, No. 6801, for "process for purifying fatty bodies."

In testimony whereof I, M. D. Leggett, Commissioner of Patents, have caused the seal of the Patent-Office to be hereunto affixed this sixth day of September, in the year of our Lord one thousand eight hundred and seventy-one, and of the Independence of the United States the ninety-sixth.

(SEAL OF U. S. PATENT-OFFICE.)

M. D. LEGGETT,
Commissioner.

2 D. $10 rec'd.

PHILA., *August* 4, 1854.

To the Commissioner of Patents:

SIR: I enclose the specification, drawings, and a certificate of deposit of $10, being the application for a patent by Richard A. Tilghman for a process of "treating fatty and oily bodies," a caveat for which, with fee of $20, was received by you 31st March, 1854. I forward this day, per Adams Express, a box of specimens.

A patent for Great Britain was granted R. A. Tilghman for this invention, dated 9th January, 1854, the specification whereof was enrolled July 8, 1854; as the U. S. caveat was filed 31st March, 1854, in-
1005 formation is requested whether, under the rules of the office, the U. S. patent (if granted) will necessarily be dated back, and how far.

Mr. R. A. Tilghman being absent in Europe, the office is requested to correspond with,

Y'rs re'p'y,

B. C. TILGHMAN,
200] 10 *Prune st., Philad'a.*

(On the back:) Letter from B. C. Tilghman, enclosing appl'n of R. A. Tilghman. Rec'd and filed Aug. 5, 1854. S. T. S.

To the Commissioner of Patents:

The petition of Richard Albert Tilghman, of Philadelphia, Pa., respectfully represents:

That your petitioner has invented a new and improved mode of "treating fatty and oily bodies," which he verily believes has not been known or used prior to his invention thereof. He therefore prays that letters-patent of the United States may be granted to him therefor, vesting in

him and his legal representatives the exclusive right to the same, upon the terms and conditions expressed in the act of Congress in that case made and provided, he having paid thirty dollars into the treasury and complied with other provisions of said act.

R. A. TILGHMAN.

CONSULATE OF THE UNITED STATES OF AMERICA, LONDON.

On this thirteenth day of July, 1854, before the subscriber, consul of the United States of America for London and the dependencies thereon, personally appeared the within named Richard Albert Tilghman,
1006 and made solemn oath that he verily believes himself to be the original and first inventor of the mode herein described for treating fatty and oily bodies, and that he does not know or believe the same was ever before known or used; and that he is a citizen of the United States. That he has obtained a patent for the said invention from the Queen of Great Britain, bearing date the 9th of January, 1854.

(SEAL OF AMERICAN CONSULATE, LONDON.)

R. A. TILGHMAN.

GEORGE N. SANDERS,
Consul United States, London.

To all whom it may concern:

Be it known that I, Richard Albert Tilghman, of Philadelphia, have invented a new and improved mode of treating fatty and oily bodies; and

I hereby declare that the following is a full and exact description thereof:

[The first part of]* my invention consists of a process for producing free fat acids and solution of glycerine from those fatty or oily bodies of animal and vegetable origin which contain glycerine as their base.

For this purpose I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain, at the same time, free fat acids and solution of glycerine.

I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting-point of lead, until the operation is complete.

1007 The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

The process may be performed more rapidly, and also continuously, by causing the mixture of fatty matter and water to pass through a tube or continuous channel, heated to the temperature already mentioned, the requisite pressure for preventing the conversion of water into steam being applied during the process; and this, I believe, is the best method of carrying my invention into effect.

In the drawing hereunto annexed are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention. Fig. 1 of the said drawing is a vertical section of this apparatus, and Fig. 2

* The words "the first part of," between the brackets, are erased, and over them is written, "cancelled R. A. Tilghman, by his att'y, W. M. Tilghman, Sept. 16, 1854."

shows the various parts of the apparatus in horizontal section; similar parts in these figures being marked with similar letters of reference.

I place the fat or oil in a fluid state in the vessel *a*, with from one-third to one-half its bulk of warm water; the disk or piston *b*, perforated with numerous small holes, being kept in rapid motion up and down in the vessel *a*, causes the fat or oil and water to form an emulsion or intimate mechanical mixture. A force-pump, *c*, like those in common use for hydraulic presses, then drives the mixture through a long coil of very strong iron tube, *d d d d*, which, being placed in the furnace *e e* is heated by a fire, *f*, to about the temperature of melting lead.

From the exit end, *g*, of the heating-tubes, *d d*, the mixture, which has then become converted into free fat acids and solution of glycerine, passes on through another coiled iron tube, *h h h*, immersed in water, by which it is cooled down from its high temperature to below 212° F., after which it makes its escape through the exit valve *i* into the receiving vessel.

1008 The iron tubes I have employed and found to be convenient for this purpose are about one inch external diameter and about half an inch internal diameter, being such as are used in common use for Perkins' hot water apparatus. The ends of the tubes are joined together by welding, to make the requisite length; but where welding is not practicable I employ the kind of joints used for Perkins' hot water apparatus, which are now well known. The heating-tube, *d d d*, is coiled several times backwards and forwards, so as to arrange a considerable length of tube in a moderate space. The different coils of the tube are kept about a quarter of an inch apart from each other, and the interval between them is filled up solid with cast iron, which also covers the outer coils or rows of tubes to the thickness of half or three-quarters of an inch, as shown in Fig. 2. This casing of metal insures a considerable uniformity of temperature in the different parts of the coil, adding also to its strength, and protecting it from injury by the fire.

The exit valve *i* is so loaded that when the heating-tubes *d d d* are at the desired working temperature, and the pump *c* is not in action, it will not be opened by the internal pressure produced by the application of heat to the mixture, and, therefore, when the pump *c* is not in action, nothing escapes from the valve *i* if the temperature be no' too high. But when the pump forces fresh mixture into one end *j* of the heating-tubes *d d d*, the exit valve *i* is thereby forced open to allow an equal amount of the mixture, which has been operated upon, to escape out of the cooling tubes *h h* at the other end of the apparatus.

No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture. For this purpose, whenever it may be required, the speed of the pump should be increased

1009 so that the current through the tubes may be made sufficiently vapid to carry out with it any air remaining in them.

Although the decomposition of the neutral fats by water takes place with great quickness at the proper heat, yet I prefer that the pump *c* should be worked at such a rate in proportion to the length or capacity of the heating-tubes *d d d*, that the mixture, while flowing through them, should be maintained at the desired temperature for ten minutes before it passes into the refrigerator or cooling parts, *h h*, of the apparatus.

The melting-point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matters into fat acid and glycerine takes place with some materials (such as palm-oil) at or below the melt-

ing-point of bismuth; yet the heat has been carried considerable above the melting-point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat, gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed can easily be determined.

To indicate the temperature of the tubes *d d d*, I have found the successive melting of metals and other substances of different and known degrees of fusibility, to be convenient in practice. Several holes, half an inch in diameter, and two or three inches deep, are bored into the solid parts of the casting surrounding the tubes, each hole being charged with a different substance. The series I have used consist of tin, melting at about 440° F.; bismuth, at about 510° F.; lead, at about 612° F.; and nitrate of potash, at about 660° F. A straight piece of iron wire, passing through the side of the furnace to the bottom of each of the holes, enables the workman to feel which of the substances are
1010 melted, and to regulate the fire accordingly. It is important for the quickness and perfection of the decomposition that the oil and water, during their entire passage through the heating-tubes, should remain in the same state of intimate mixture in which they enter them. I therefore prefer to place the series of heating-tubes in a vertical position, so that any partial separation which may take place while the liquids pass up one tube may be counteracted as they pass down the next. I believe that it will be found useful to fix, at intervals in the heating-tubes, diaphragms pierced with numerous small holes, so that the liquids, being forced through these obstructions with great velocity, may be thoroughly mixed together. I deem it prudent to test the strength of the apparatus by a pressure of ten thousand pounds to the square inch before taking it into use; but I believe that the working-pressure necessary in using the heat I have mentioned will not be found to exceed two thousand pounds to the square inch. When it is desired to diminish the contact of the liquids with iron, the tubes or channels of the apparatus may be lined with copper. The hot mixture of fat acids and solution of glycerine, which escapes from the exit-valve of the apparatus, separates by subsidence. The fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means. The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soap, and applied to various purposes, according to their quality; and, when desired, they may also be first bleached by chemical agents, or purified by distillation in a current of steam, or in a vacuum, as is now well understood. I prefer that the fatty bodies should be previously deprived, as far as practicable, of such impurities as would cause the discoloration of the fat acids produced; but when the
1011 fat acids are to be finally purified by distillation, this preliminary purification is of less importance. When sulphuric acid, nitrous fumes, or other corrosive agent shall have been used for purifying, hardening, or otherwise preparing the fatty bodies to be operated upon, I take care that all traces of it shall be washed out or neutralized before passing it through the apparatus. Some fatty bodies (particularly when impure) generate, during the process, a portion of acetic or other soluble acid, which might tend to injure the iron tubes. In such cases I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes.

This second part of this specification and the second claim are cancelled, in order to form the subject of a separate application for letters-patent. R. A. Tilghman, by his attorney, W. M. Tilghman. Sept. 16, 1854.

[The second part of my invention consists in a process for producing soap by acting on the fatty or oily body by a solution of carbonated alkali.

For this purpose I mix the fatty bodies in a liquid state with the quantity of carbonated alkali in solution which may be necessary to convert it into soap, and then subject the mixture to a high temperature and pressure, in like manner as hereinbefore described in practicing my mode of obtaining fatty acids and glycerine. And for this purpose the apparatus hereinbefore described for producing the fatty acids and glycerine by a continuous process may be used for the production of soap in a similar manner. The carbonated alkali may be dissolved merely in the quantity of water intended to remain in the soap produced. If resinous or other matters are intended to be used in the manufacture of the soap, they may be dissolved either in the alkaline solution or the oil, or may be combined with the soap after it has left the apparatus.

The degree of heat required is less than that which is necessary to produce free fat acids, and should generally be kept between the melting-points of tin and bismuth. At about
1012 350° F. the neutral fats will form soaps with the alkaline carbonates, but a higher temperature will produce the result more quickly.

The carbonic acid expelled from the alkali in this process, when performed in the apparatus above described, escapes as the soap issues from the exit valve. If but little water has been used, and the quality of the soap is sufficiently good without further purification, it can be put into frames to harden at once; or it may be put into the coppers, boiled up, and separated from the glycerine, and finished in the usual manner.]

Canceled as within set forth. R. A. Tilghman, by his attorney, W. M. Tilghman. Sept. 16, 1854.

Having now described the nature of my said invention, and the manner of performing the same, I hereby declare that I claim as of my invention: [First.]* The manufacturing of fat acids and glycerine from fatty bodies, by the action of water at a high temperature and pressure;

Cancelled as within set forth. R. A. Tilghman, by his attorney, W. M. Tilghman, Sept. 16, 1854.

[and secondly: The manufacturing of soap from fatty bodies by the action of a solution of carbonated alkali at a high temperature and pressure.]

R. A. TILGHMAN.

Witnesses:
JAMES M. CURLEY.
JOHN R. DARKER,
[L. S.] *Consulate of the United States, London.*

CONSULATE OF THE UNITED STATES OF AMERICA AT LONDON.

I, George Nicholas Sanders, consul of the United States of America for London and the dependencies thereof, do hereby make known and certify to all whom it may concern, that on the day of the date hereof, before me personally appeared and came Richard Albert Tilgh-
1013 man, to me known to be the person described in, and who has executed the annexed specification or instrument, and then and there acknowledged the same to be his free act and deed.

* The word "First" between the brackets is erased, and over it is written "Cancelled, R. A. T., by W M. T."

In testimony whereof I have hereunto set my hand and affixed the seal of the consulate of the United States, at London aforesaid, this thirteenth day of July, in the year of our Lord one thousand eight hundred and fifty-four, and in the seventy-ninth year of the Independence of the said United States.

{ SEAL OF AMERICAN CONSULATE, LONDON. }

GEORGE N. SANDERS.

(On the back:) Petition, specification, oath, etc. Rec'd and filed Aug. 5, 1854. (3029.) S. T. S.

PHILADELPHIA, *Aug.* 7, 1854.

To the Commissioner of Patents:

SIR: I have received yours of Aug. 5th, stating that, "on receipt of the model," the application of R. A. Tilghman for a patent for an improvement in "treating oils," etc., would be taken up for examination in its order.

I beg to submit that this is a case which does not admit of representation by model, as the invention, or, more properly, the discovery, consists in the observation that, by applying a certain amount of heat and pressure to a mixture of oil and water, or watery solution, certain chemical changes take place in the constitution of the oil. In his specification the inventor has given a drawing and description of an apparatus in which the process may be conveniently carried on; but he ex-
1013 pressly states that he "does not intend to claim said apparatus as forming any part of his invention." In fact, the form of apparatus in which the materials are treated, according to the invention, may be indefinitely varied to suit the ideas of the constructor, the only essential point being that it shall be capable of withstanding the necessary heat and pressure. A model of the form of apparatus represented by the drawing would be worse than useless for the purpose of illustration and explanation, inasmuch as the essential parts are the internal passages and connections of metal tubes, pumps, and valves, incapable of being shown by model. To furnish it as "a model of his invention," when in his specification he has expressly declared it forms no part thereof, would be manifestly contradictory and absurd. In conclusion, I would urge: 1. That it is, in the nature of things, impossible to furnish a model of that which does constitute this invention, viz, the application of heat and pressure to mixtures of oil, water, etc., to produce certain results; and 2, that the inventor cannot properly be asked to furnish a model of apparatus which he has declared to form no part of his invention.

I therefore request that this application may be placed upon the list for examination without a model, and that the decision of the office upon this point may be communicated to me.

Very respectfully,
440

B. C. TILGHMAN,
10 *Pine street, Phila.*

32 SANSOM STREET,
Philadelphia, Sept. 16, 1854.

SIR: I have to acknowledge the receipt of your favor of the 13th inst., enclosing for alteration Mr. R. A. Tilghman's specification of his application for a patent for a new mode of "treating fatty and
1015 oily bodies," and stating that you consider it objectionable, as embracing the subjects of two distinct applications.

In compliance with your suggestion, I have cancelled one of the claims, to wit, that for "the manufacturing of soap from fatty bodies by the action of a solution of carbonated alkali at a high temperature and pressure," with the description thereto belonging.

The claim and description thus cancelled will, of course, form the subject of a separate application.

Some delay in making it, however, must occur, in consequence of Mr. R. A. Tilghman's continued absence in London.

I shall send your letter to him by next steamer, and expect to receive the new application and forward it to your office towards the close of next month.

I now return, enclosed, the original application and specification, with the claim and description above referred to, marked thereon by me as "cancelled, in order to form the subject of a separate application for letters-patent."

In regard to the request for specimens of the products obtained by the process, I could observe that a box containing such specimens was forwarded to your office, per Adams' Express, on the 4th ult., a notice of which you will find in Mr. B. C. Tilghman's letter to you of that date. If, upon inquiry, it should appear that the box has not been received, or has been lost or mislaid, I will, if the point is insisted upon, send out to Mr. R. A. Tilghman's for a new supply of specimens.

I would respectfully submit, however, that this is not a case in which, by law, a deposit of specimens is necessary.

The words of the law are, "or with specimens of the ingredients, and of the composition of matter, sufficient in quantity for the purpose of experiment, where the invention is of a composition of matter."

1016 Now, the present invention is not of "a composition of matter."

It is not the making of a new thing, but of an old thing by a new way. Fat acids and glycerine are well-known chemical substances, whose "composition" is the same, whether they are made by one process or another; and the invention specified is simply of a new method of making them.

If my brother (Mr. R. A. Tilghman) were here, there would, of course, be no difficulty in at once sending on fresh specimens; but, owing to his absence, delay and trouble must now occur in procuring them, and hence I trust that if those already sent should not be found, the question as to the legal necessity for their deposit will be duly considered. The very point, in a precisely similar case, was decided by your predecessor, Mr. Burke, on the 13th January, 1848, as you may see by referring to the office-copy of his letter to me of that day, in reply to one from me of the day preceding.

My brother, (Mr. R. C. Tilghman,) who has heretofore corresponded with you upon this business, sailed for Europe on the 6th inst., and the matter being now in my charge as attorney for Mr. R. A. Tilghman, I have to request that your letters in regard to it should be addressed to

Your obedient servant,

W. M. TILGHMAN,
32 Sansom street, Phila.

C. MASON, Esq.,
Commissioner of Patents,
City of Washington, D. C.

(On the back:) Filed 18th Sept., 1854. J. Y. H:
REC. 340—39

WASHINGTON, 13*th Sept.*, '55.

1017 The specification of your application for letters-patent for treating oily and fatty substances has, after due examination, been found to embrace the subjects of two distinct applications.

Abstract philosophical principles are not patentable, but the application of them to definite practical purposes.

The action of a high temperature upon an emulsion of fat and water, if discovered by you, cannot give you a right to a patent, because this would involve a philosophical principle only, and because it would prevent the public from investigating the practical results of the abstraction.

It is a different case with the separation of free fatty acids from glycerine, and with the manufacture of soap. Both manufactures, as described by you, involve the application of your abstract philosophical principle to practical purposes; yet, as said purposes are clearly distinct from each other, the processes employed in them, and the materials to be used equally distinct, and the products to be obtained distinct, are widely different, said processes cannot be claimed by you, in one application, and under the same fee, any more than any future application of your abstract and philosophical discovery to useful purposes which might be discovered hereafter by anybody, perhaps yet unborn to-day.

You will therefore find enclosed your specification, in which you will please to cancel one of your claims, with the description belonging thereto, it being, of course, left with you to apply for it under a separate fee.

You will also please to send some specimens of your crude materials, and the product obtained by you therefrom by your process.

R. A. TILGHMAN, esq.,
(Care of B. C. Tilghman,)
10 *Pine Street, Philadelphia, Pa.*

J. Y. pour L.
1018 V 3029 × × 3 54

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No. 11,766.
R. A. TILGHMAN,
Of Philadelphia,
County of Philadelphia,
State of Pennsylvania.
Treating oily and fatty substances.
Rec'd Aug. 5, 1854.
Petition, " " "
Affidavit, " " "
Specification, " " "
2 Drawings, " " "
Model. No model required.
Spec'n rec'd 10 Aug.
1 Cert. dep. $10. Aug. 5, 1854.
Caveat, March 31, 1854.
2 Examined L. D. Gale, 19 Sept., 1854.
Issue Thugert, Sept. 19, '54.
Patented October 3, 1854. ×
3 Recorded vol. 59, page 116.
3 English patent, dated 9th Jan'y, 1854.

File rec'd Aug. 8, in dr't room.

Care of W. M. Tilghman.
B. C. Tilghman, on
Special letter, Aug. 8. 10 Prune st.,
O 32 Samson st., Phila., Pa.
Phil.

(On the back:) Ex'd. H. H. Spe. ret. for dw'n, 13 Sept'r, '54, improv't in processes for purifying fatty bodies, P. IV, 443.

1019 [BRITISH COAT OF ARMS.]

A. D. 1854.] [No. 47.

Specification of Richard Albert Tilghman. Process and apparatus for treating fatty and oily matters to obtain their acids and glycerine, and for the manufacturing of soap.

London: Printed by George E. Eyre and William Spottiswoode, printers to the Queen's most excellent Majesty. Published at the Queen's printing office, East Harding street, near Fleet street. Price 6d. 1854.

[BRITISH COAT OF ARMS.]

A. D. 1854.] [No 47.

Process and apparatus for treating fatty and oily matters to obtain their acids and glycerine, and for the manufacture of soap. Letters-patent to Richard Albert Tilghman, of Philadelphia, United States of America, chemist, for the invention of "improvements in treating fatty and oily matters, chiefly applicable to the manufacture of soap, candles, and glycerine." Sealed the 25th March, 1854, and dated the 9th January, 1854.

Provisional specification left by the said Richard Albert Tilghman at the office of the commissioners of patents with his petition, on the 9th January, 1854.

1020 I, Richard Albert Tilghman, of Philadelphia, United States of America, chemist, do hereby declare the nature of my invention for "improvements in treating fatty and oily matters, chiefly applicable to the manufacture of soap, candles, and glycerine," to be as follows:

The first part of my invention consists in a new method of obtaining free fat acids and solution of glycerine from animal and vegetable fatty and oily bodies which have glycerine as their base. Two processes are now practiced for this purpose: One called the saponification process, making use first of lime to decompose the fat, (forming a lime-soap,) and then of some strong acid to neutralize and remove the lime, leaving the fat acids in a free state.

In the other process the fat is heated with concentrated sulphuric acid, which so acts upon or combines with the glycerine of the fat that boiling with water removes both of them, leaving the fat acids in a free state.

Now, my invention consists in exposing the aforesaid fats and oils to the action of water at a high temperature and pressure, the effect of which is to cause the combination of the water with the elements of the neutral fats, so as to produce at the same time free fat acids and a so-

lution of glycerine. Those fats which, like palm-oil, are highly colored, are also to some extent bleached in the process, and the strong-smelling oils are more or less deodorized. The operation is performed in a continuous manner by pumping an intimate mixture of the fat and water through a very strong metallic vessel heated to the requisite degree. From it the mixture (now changed into free fat acids and solution of glycerine) escapes through a safety-valve so heavily loaded as not to open by the mere pressure of the steam. The solution of glycerine settles from the hot fat acids, and may be purified as usual. The
1021 fat acids may be used for making soap and candles at once, or bleached by any of the ordinary methods, or may be distilled with hot steam in the usual manner.

The second part of my invention relates to the manufacture of soap. It is performed in the same apparatus and manner just described for fat acids, but first dissolving in the water used the alkaline and other matter required to produce soap, with the neutral or acid fatty matter employed. The soap, as it issues from the safety-valve, may be put into the frames at once or washed and finished in the usual manner. By this process carbonated alkalies act as well as the more expensive caustic ones. Colored and bad-smelling fats, by this treatment, make bleached and deodorized soaps, but sometimes require a higher heat than when white and inodorous fats are used.

Specification in pursuance of the conditions of the letters-patent filed by the said Richard Albert Tilghman in the great seal patent-office on the 8th July, 1854:

To all to whom these presents shall come, I, Richard Albert Tilghman, of Philadelphia, United States of America, chemist, send greeting:

Whereas Her most excellent Majesty, Queen Victoria, by her letters-patent, bearing date the ninth day of January, in the year of our Lord eighteen hundred and fifty-four, in the seventeenth year of her reign, did for herself, her heirs, and successors, give and grant unto me, the said Richard Albert Tilghman, her special license, that I, the said Richard Albert Tilghman, my executors, administrators, and assigns, or such others as I, the said Richard Albert Tilghman, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time, and at all times thereafter during the
1022 term therein expressed, should, and lawfully might, make, use, exercise, and vend within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an invention for "improvements in treating fatty and oily matters, chiefly applicable to the manufacture of soap, candles, and glycerine," upon the condition (amongst others) that I, the said Richard Albert Tilghman, by an instrument in writing under my hand and seal, should particularly describe and ascertain the nature of the said invention, and in what manner the same was to be performed, and cause the same to be filed in the great-seal patent-office within six calender months next and immediately after the date of the said letters-patent.

Now know ye that I, the said Richard Albert Tilghman, do hereby declare the nature of the said invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, (that is to say:)

The first part of my said invention consists of a mode or modes or mode of obtaining free fat acids and solution of glycerine from those fatty or oily bodies of animal and vegetable origin which contain glycerine as their base.

For this purpose I subject these fatty or oily bodies to the action of water at a high temperature under pressure, so as to cause the elements of those bodies to combine with water, and to obtain, at the same time, free fat acids and a solution of glycerine.

I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be subjected to the action of heat to a temperature about the same as that of melting lead, until the operation is complete; and the vessel must be closed, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

1023 The process may be performed more rapidly and also continuously by causing the mixture of fatty matter and water to pass through a tube or continuous channel, heated to the temperature already mentioned; the requisite pressure for preventing the conversion of the water into steam being applied during the process, and this, I believe, is the best mode of carrying this part of my invention into effect.

In the drawing hereunto annexed are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention. Fig. 1 of the said drawing is a vertical section of this apparatus, and Figure 2 shows the various parts of the apparatus in horizontal section; similar parts in these figures being marked with similar letters of reference. I place the fat or oil, in a fluid state, in the vessel *a*, with from one-third to one-half its bulk of warm water; the disc or piston *b*, perforated with numerous small holes, being kept in rapid motion, up and down in the vessel *a*, causes the fat or oil and water to form an emulsion or intimate mechanical mixture. A force-pump, *c*, like those in common use for hydraulic presses, then drives the mixture through a long coil of very strong iron tube, *d d d d*, which, being placed in a furnace, *e e*, is heated by a fire, *f*, to about the temperature of melting lead. From the exit end *g*, of the heating-tubes *d d*, the mixture, which has then become converted into free fat acids and solution of glycerine, passes on through another coiled iron tube, *h h h*, immersed in water, by which it is cooled down from its high temperature to below 212° Fahrenheit thermometer, after which it makes its escape through the exit-valve *i*, into the receiving vessel. The iron tubes I have employed and found to be convenient for this purpose are about one inch external diameter, and about half an inch internal diameter, being such

1024 as are in common use for Perkins' hot-water apparatus. The ends of the tubes are joined together by welding, to make the requisite length, but where welding is not practicable, I employ the kind of joints used for Perkins' hot-water apparatus, which are now well known. The heating-tube *d d d* is coiled several times backwards and forwards, so as to arrange a considerable length of tube in a moderate space. The different coils of the tube are kept about one-quarter of an inch apart from each other, and the interval between them is filled up solid with cast iron, which also covers the outer coils or rows of tubes, to the thickness of half or three-quarters of an inch, as shown in Fig. 2. This casing of metal insures a considerable uniformity of temperature in the different parts of the coil, adding also to its strength and protecting it from injury by the fire.

The exit-valve *i* is so loaded that, when the heating-tubes *d d d* are at the desired working temperature, and the pump C is not in action, it will not be opened by the internal pressure produced by the

application of heat to the mixture; and therefore, when the pump *c* is not in action, nothing escapes from the valve *i*, if the temperature be not too high. But when the pump forces fresh mixture into one end, *j*, of the heating-tubes *d d d*, the exit-valve *i* is forced open, to allow an equal amount of the mixture which has been operated upon to escape out of the cooling-tubes *h h*, at the valve *i*, placed at the other end of the apparatus. No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture. For this purpose, whenever it may be required, the speed of the pump should be increased, so that the current through the tubes may be made sufficiently rapid to carry out with it any air remaining in them. Although the decomposition of the neutral fats by water takes place with great quickness at the proper heat, yet I prefer that the
1025 pump *c* should be worked at such a rate in proportion to the length or capacity of the heating-tubes *d d d* that the mixture, while flowing through them, should be maintained at the desired temperature for about ten minutes before it passes into the refrigerator or cooling parts *h h* of the apparatus.

The melting-point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matters into fat acids and glycerine takes place with some materials (such as palm-oil) at the melting-point of bismuth; yet the heat has been carried considerably above the melting-point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat, and gradually increasing it, the temperature-giving products most suitable to the intended application of the fatty body employed can easily be determined.

To indicate the temperature of the tubes *d d d*, I have found the successive melting of metals and other substances of different and known degrees of fusibility to be convenient in practice. Several holes, half an inch in diameter, and two or three inches deep, are bored into the solid parts of the castings surrounding the tubes, each hole being charged with a different substance. The series I have used consist of tin melting at about 440°; bismuth at about 510°; lead at about 612°; and nitrate of potash at about 660°. A straight piece of iron-wire passing through the side of the furnace to the bottom of each of the holes, enables the workman to feel which of the substances are melted, and to regulate the fire accordingly. It is important, for the quickness and perfection of the decomposition, that the oil and water, during their entire passage through the heating-tubes, should remain in the same state of intimate mixture in which they enter them. I therefore
1026 prefer to place the series of heating-tubes in a vertical position, so that any partial separation which may take place while the liquids pass up one tube, may be counteracted as they pass down the next. I believe that it will be found useful to fix at intervals, in the heating-tubes of such apparatus as may admit of such an addition, diaphragms pierced with numerous small holes, so that liquids, being forced through these obstructions, may be thoroughly mixed together. I deem it prudent to test the strength of the apparatus by a pressure of ten thousand pounds to the square inch, before taking it into use. But I believe that the working-pressure necessary for producing the heat I have mentioned will not be found to exceed two thousand pounds to the square inch. When it is desired to diminish the contact of the liquids with iron, the tubes or channels of the apparatus may be lined with copper.

The hot mixture of fat acids and solution of glycerine which escape' from the exit-valve of the apparatus are separated from each other by subsidence. The fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means.

The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soap, and applied to various purposes, according to their quality; and, when desired, they may also be first bleached or purified by distillation or otherwise, as is now well understood.

I prefer that the fatty bodies should be previously deprived, as far as practicable, of such impurities as would cause the discoloration of the fat acids produced; but when the fat acids are to be finally purified by distillation, this preliminary purification is of less importance.

When any acid or other corrosive agent shall have been used for purifying, hardening, or otherwise preparing the fatty body to be op-
1027 erated upon, I take care that all traces of it shall be washed out, or neutralized before passing it through the apparatus. Some fatty bodies (particularly when impure) generate, during the process, a portion of acetic or other soluble acid, which might tend to injure the iron tubes. In such cases, I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes.

The second part of my said invention consists of a mode of treating a mixture of fatty matters (whether acid or neutral) and a carbonated alkali, for the purpose of manufacturing soap.

For this purpose I mix the fatty bodies, in a liquid state, with the quantity of carbonated alkali in solution which may be necessary to convert it into soap, and then subject the mixture to a high temperature under pressure, in like manner as hereinbefore described in practising my mode of obtaining fatty acids and glycerine. And for this purpose the apparatus hereinbefore described, for producing the fatty acids and glycerine by a continuous process, may be used for the production of soap in a similar manner. The carbonated alkali may be dissolved merely in the quantity of water which is intended to remain in the soap produced. If resinous or other matters are intended to be used in the manufacture of the soap, they may be dissolved either in the alkaline solution or the oil, or may be combined with the soap after it has left the apparatus.

The degree of heat required is less than that which is necessary to produce free fat acids, and should generally be kept between the melting-points of tin and bismuth. At about three hundred and fifty degrees of Fahrenheit the neutral fats will form soaps with the solution of alkaline carbonates, but a higher temperature will produce the result more quickly.

The carbonic acid expelled from the alkali in this process, when performed in the apparatus above described, escapes as the soap is-
1028 sues from the exit-valve. If but little water has been used, and the quality of the soap is sufficiently good without further purification, it can be put into frames to harden at once, or it may be put into the coppers, boiled up, and separated from the glycerine, (when neutral fats have been used,) and finished in the usual manner.

Having now described the nature of my said invention, and the manner of performing the same, I hereby declare that I claim, as of my invention—

First, the manufacturing of fatty acids and glycerine from fatty bod-

ies by means of water and heat acting thereon, as hereinbefore described.

And, secondly, the manufacturing of soap by treating a mixture of fatty matters and a carbonated alkali as above described.

In witness whereof I, the said Richard Albert Tilghman, have hereunto set my hand and seal this eighth day of July, in the year of our Lord one thousand eight hundred and fifty-four.

R. A. TILGHMAN. [L. S.]

Witness—
J. G. TONGUE.

London: Printed by George Edward Eyre and W'm Spottiswoode, printers to the Queen's Most Excellent Majesty. 1854.

1029 *Complainant's Exhibit S.—Compt's rec., Tilghman vs. Mitchell, 1st suit, p. 115.*

[From Brevets d'Invention, 2d series, vol. 37, page 15.]

Copy of French letters-patent granted to R. A. Tilghman, March 22d, 1854. No. 10731.

PATENT FOR INVENTION.

(English patent of 9th January, 1854,) dated 22d March, 1854, to Mr. Tilghman, in Philadelphia, (America.) For new processes in the treatment of fatty and oily substances, principally applicable to the manufacturing of soap, wax-candles, and glycerine. Pl. IV.

The first part of my invention consists in a new process in the manufacturing of oleaginous neutral acids, and produces also a solution of glycerine, by the treatment of fatty or oily substances of animal or vegetable origin, which have glycerine for their basis.

I arrived at this result by submitting these fatty or oily substances to the action of heated water under a strong pressure, and at a high temperature. The effect of this treatment is to determine the combination of the water with the elements of the oleaginous neutral substances in such a manner as simultaneously to produce oleaginous acids and a solution of glycerine.

This operation takes place without intermission. Thus the fatty or oily substances are immediately incorporated in a perfect mixture with hot water, by means of precipitated agitation.

One has to take three parts of water to one part of the oleaginous substance.

1030 This combination, thus obtained, is conducted through a long series of very strong iron tubes, which are heated at a temperature equal to that requisite for the melting of lead.

When issuing from these heating-tubes, the mixture which, by this process, has been converted into oleaginous acids, and into a solution of glycerine, passes into a tube, where its heat is reduced to 100 degrees centigrade, and finally escapes by a safety-valve, and runs into a receptacle.

This safety-valve is loaded with a somewhat heavy weight, in order that it may not be displaced at the moment of the requisite heat by the pressure produced by the heated water. But as soon as a fresh quantity of the liquid mixture is by means of the pump introduced into one

of the extremities of the heated tubes, the safety-valve opens, so as to permit an equal quantity of the combination, thus obtained, to escape from the cooling-tube to the other extremity of the apparatus.

Great care has to be taken against accumulation of air or steam in the tubes, which must be entirely filled with the liquid in operation; when it becomes necessary, a current is to be produced, sufficiently rapid to expel, along with itself, the least quantity of air remaining in the tubes.

In order to obtain a complete and rapid decomposition, it is important that the oleaginous substance and the water remain, during their entire passage through the heating-tubes, in the same state of perfect mixture in which they were before entering them; to this end I place at certain distances, in the interior of the tubes, diaphragms of metal, perforated with small holes. The rapidity with which the substances are expelled through these holes forces them into a thorough mixture.

I prefer, also, to place the tubes which compose my apparatus, in a vertical position, in order that any deposit that might be formed during the passage of the mixture through the top of one tube, find'
1031 itself counterbalanced in its passage at the bottom of another tube.

The whole apparatus should, before being used, be tested at a pressure of seven hundred atmospheres.

When it is desired to diminish the contract of the liquid with the iron, one puts a lining of copper tubes within the iron ones, before the latter are connected.

Although the decomposition of oleaginous substances, by means of water, takes place with great celerity at a suitable heat, nevertheless, in practice, I prefer using heating-tubes of such length and diameter that the mixture which traverses them may be maintained at the desired temperature for ten minutes, before arriving at the cooling part of the apparatus.

The tubes can be heated by a furnace, by a metallic bath, or by any other suitable and uniform means.

The point of fusion of lead has been ascertained as being suitable to this operation, and has, almost always, produced good results; nevertheless, some variations may, in certain cases, become necessary, depending not only upon the kind and upon the purity of the oleaginous substances employed, but also upon the application one desires to make of the oleaginous acids produced; that is to say, according as they are wanted for the manufacturing of wax-candles or soap, or whether they are to be unbleached or distilled.

With some substances the transformation into oleaginous acids and into glycerine occurs at the point of fusion of bismuth, and thus the heat has been increased far beyond the point of fusion of lead without apparent injury.

When the apparatus is made to work, at first at a low temperature, to be gradually raised, results are produced which are the most suitable to the desired application. This can be ascertained and con-
1032 tinued. Whenever economy in fuel is an important object, the produced mixture may, when issuing from the heating-tubes, give off part of its heat to the new mixture which enters into these same tubes.

The pressure with which the obtained mixture escapes from the cooling-tubes can be used, and can serve to diminish the power necessary for putting the force-pump in motion.

The principles upon which these arrangements must be carried out,

being perfectly well known by chemists, it is unnecessary to describe them.

The oleaginous acids and the solution of glycerine mixed and heated, which escape through the safety-valve of the apparatus, are separated from each other by rest and washing.

The solution of glycerine, which ordinarily has an acidiferous reaction, is purified by ordinary means.

The oleaginous neutral acids, as well as those obtained by other methods, may, according to their qualities and the application one desires to make of them, afterwards be used for manufacturing wax-candles or soap, or they may be, at first, bleached by chemical agents, or purified by distillation, by means of a current of steam, in the usual manner.

Oleaginous substances which, like palm-oil, are strongly colored, give, by means of the described process, less colored products, and produce white soaps, or, when distilled, render white oleaginous acids.

Ill-smelling oleaginous substances are likewise disinfected, and yield, when subjected to the same treatment, white inodorous products.

The second part of my invention has reference to the manufacturing of soap. It consists in submitting the fatty and oily substances of animal or vegetable origin, if they be in the condition of oleaginous neutral substances or oleaginous acids, to the action of a solution of alcaline carbonate at a high temperature, which produces soap.

1033 The operation is performed by means of the apparatus and by the process described above for oleaginous acids.

The carbonate is first dissolved in water, which, if it is preferred, need not be in greater quantity than that which is to remain in the soap to be produced.

When resinous or other substances are to be employed in the soap, they are either previously to be dissolved in oil or by alcali, or else they are to be combined with the soap when it comes out of the apparatus.

The necessary heat is lower than that required for the production of oleaginous acids; it must be kept up between the points of fusion of bismuth and of tin, and even at about 200 degrees centigrade. Oleaginous neutral substances would form soaps with the alcaline carbonates.

When operating at too great a heat, the soap which escapes by the safety-valve has a special and disagreeable odor.

The soap may then be made to run into the moulds, or brought to a state of ebullition, and separated from the glycerine, when the oleaginous neutral substances have been used, after which one operates as usual.

By means of this process, the colored and ill-smelling oils produce white and odorless soaps.

Additional certificate, dated 23d February, 1855.

In order to carry out my invention with the greater success, I use the apparatus represented, Plate IV.

Figure 1 represents an elevation of which Figure 2 is the plane.

In these figures, *a* is the vat into which the substances arrive, which flow through the stop-cock *k*, and the hot water through the stop-cock *e*; they blend and form, by means of the rapid movement of the alternate motion of the piston *b*, a perfect mixture.

1034 This piston *b* is perforated with very fine holes.

e, force-pump, serving to conduct the mixture of water and oil to the curved iron tube *d d d d*. The latter is heated at the suitable degree above the hearth.

Having traversed the heating-tube, the mixture, which is now converted into oleaginous acids and into a solution of glycerine, passes through the tube *g*, in order to arrive in the cooling-tube *h h*, where it it is cooled off to below 100 degrees centigrade; then, forcing its passage through the safety-valve *i*, it falls back into the receptacle. In order to employ a great length of heating-tube in a small space, this tube is adjusted in spirals, separated from each other by a space of about 6 millimeters. This interval is filled with melted metal, which also serves to cover the extreme part of the spirals by the thickness of about 6 millimeters, as is represented by Figure 2.

This solid mass of metal insures a uniform degree of heat to all parts of the apparatus, strengthens it by adding to its power, and preserves it from the action of the fire.

Defendant's exhibit, Sept. 29, 1871.—*Copy of French letters-patent granted to R. A. Tilghman, February* 28, 1856. *No.* 15,129.

From Brevets D'invention, 2d series, vol. 54, page 100.

Patent of invention for fifteen years, dated 28th February, 1856, to Mr. Tilghman, of Philadelphia, (United States,) for improvements in the treatment of oleaginous substances.

1035 It is already known that by the action of water at an elevated temperature, neutral oleaginous substances are converted into oleaginous acids and into glycerine. Several systems of operation and various kinds of apparata have been proposed to effect this decomposition on a commercial scale.

The modification which I propose has for basis the well-known fact, that in effecting this decomposition these elements—the degree of heat, the length of time required for the operation, and the extent of the surface of contact—may, to a certain point, be substituted for each other. I have thus found that at a comparatively low temperature, (but above 100 degrees centigrade,) and without any artificial multiplication of the surfaces of contact of the oil with the water, this decomposition may be produced by continuing the operation for a considerable length of time, and that the temperature remaining the same in proportion as the surface of contact of the water with the oleaginous substance increases, the time necessary for the decomposition will become shorter. In the same manner, when the surface of contact is the same, the time required becomes less in proportion to the increase of the temperature.

These principles being established, their application to a manufacturing operation is easy.

Having decided upon the temperature and pressure most suitable for operating, I prepare a most thorough mixture of the oleaginous substance with water, and I continue the application of heat until the decomposition is obtained in a sufficiently complete manner.

It being the custom to use a pressure of five to seven atmospheres in boilers having a diameter of one metre and more, I consider this pressure and its corresponding temperature very well suited to a manufacturing operation, it being, however, well understood that I do not bind myself to the same, but that higher and lower temperatures and pressures may be employed, and that in the same proportion more or less time is necessary.

1036 I find, moreover, in employing this temperature, the advantage that the apparatus may be heated by the steam from the boilers ordinarily used.

I use a mechanical agitator, which brings the liquids into a perfect state of mixture, and I thus obtain a great surface of contact between the oleaginous substance and the water. The same result can be obtained, and the mixture at the same time heated, by the introduction of steam by means of a perforated tube.

The steam, after having passed through the liquid, escapes through a vent-valve, suitably adjusted. All substances having a tendency to facilitate the dissolution or mutual suspension of the oleaginous substance and the water will, in a parallel manner, be a substitute for artificial agitation; a small quantity of alcohol, of alkali, or of amyloline matter, dissolved in water, will produce this effect.

The following is an apparatus capable of decomposing about 4,000 kilogrammes of oleaginous substances at a time.

A boiler is used of $1^m.25$ diameter and $6^m.50$ long. It is of iron, of suitable strength, and lined with copper, in such a manner as to leave a space of about $0^m.01$ between the sides of the iron and those of the copper lining.

Into this cylindrical space is introduced, through an upper stop-cock, the steam, which proceeds from an ordinary boiler and at a pressure of 4 to 6 atmospheres. The condensed water and the surplus steam return to the steam-boiler by a lower stop-cock. An equal pressure is kept up between the cylindrical space and the interior of the boiler by means of tubes.

The boiler is provided with an agitator of copper, the blades of which are of metallic cloth, and its shaft, passing through a stuffing-box, is put in motion by means of a rack and a pinion, which cause it to turn continually, five or six times in one direction, and then as many times in the opposite one.

1037 The boiler is provided with suitable conducts and stop-cocks for the purpose of being filled and emptied, and with ordinary accessories, such as man-holes, stock-cocks, safety-valves, steam-gauge, thermometer, and water-gauge.

The boiler being filled about four-fifths of its capacity with a mixture of two parts of oleaginous substance and of one part of water (or in any other suitable proportion,) I cause steam to circulate at the pressure of 4 to 6 atmospheres in the cylindrical space, and I put the agitator in motion.

I continue this operation until shown by a specimen that the decomposition is sufficiently complete.

The product is then allowed to run off and the boiler is again filled. It is evident that the manner of heating the boiler, as well as the disposition of the agitator, can be varied at will.

It is ascertained that oleaginous acids possess the property of decomposing alcaline carbonates in such a manner as to produce soaps. If, now, we mix with the water of the above-described operation the necessary quantity of alcali carbonate, the formation of soap will take place in proportion to the quantity of carbonic acid eliminated by the oleaginous acids.

This carbonic acid, mixed with vapor, escapes through a safety-valve suitably adjusted, and can be utilized in various ways—as in the manufacturing of gaseous liquids, bicarbonated alcalies, &c., &c.

To prevent the escape through the safety-valve of the froth of the mixture, I place this valve on the top of a dome or cylinder, in which I

cause a centrifugal ventilator to turn round, provided with blades of metallic gauze, which separates or crushes the globules, and whips the liquid parts against the sides of the cylinder, whilst the gas escapes through the vent-pipe. In the manufacturing of soap one may
1038 dispense with the copper lining of the boiler, and the mixture can be heated by the steam which circulates in return tubes, in the well-known manner, or else by simple fire.

1039 At a stated term of the circuit court of the United States of America for the southern district of New York, in the second circuit, held at the United States court-rooms, in the city of New York, on the 29th day of May, in the year of our Lord one thousand eight hundred and seventy-two—

Present, the Hon. Samuel Blatchford, dist. judge.

RICHARD A. TILGHMAN *vs.* ROLAND G. MITCHELL. } Suit No. 2. For extended term of patent.

This cause having been brought to a final hearing upon the pleadings and proofs, and the counsel for the defendants having, in view of the decision made in a case in this court under the same patent, between the same parties, brought on the patent before it was extended, waived formal argument.

It is hereby ordered, adjudged, and decreed that the letters-patent, No. 11766, granted unto the said Richard A. Tilghman on the third day of October, 1854, is a good and valid patent, and that the said Richard A. Tilghman was the original and first inventor of the improvement described and claimed in the said patent, and that the said patent was legally and duly extended, on the 23d day of November, 1867, for term of seven years, from the 9th day of January, 1868, and that the said defendant has infringed upon the said patent and upon the exclusive rights of the complainant during the extended term of said patent.

1040 And it is further ordered, adjudged, and decreed that the plaintiff do recover from the defendant the profits and gains which the said defendant has made or received, or which have arisen or accrued to him from said infringement of the said patent by the use of the said improvement described and secured by the said letters-patent at any and all times after the ninth day of January, A. D. 1868, down to the 14th of September, A. D. 1871.

And it is further ordered, adjudged, and decreed that the said plaintiff do recover of the defendant his costs and charges in this suit to be taxed.

And it is further ordered, and adjudged, and decreed that a perpetual injunction be granted in this suit against the said defendant according to the prayer of the bill, and that the issue of the writ of injunction be suspended during the payment of the license fees or royalty stipulated to be paid by said defendant to said plaintiff.

And it is further ordered that the reference to the master to ascertain the gain and profits hereinbefore decreed having been waived by both parties, the same is reserved for the further hearing of this court.

SAM'L BLATCHFORD.

(Endorsed:) Filed May 31, 1872.

1041 R. A. TILGHMAN *vs.* R. G. MITCHELL. } No. 2. C. C. U. S.

It is agreed that the costs to be entered in the decree shall be fifty-three dollars and twenty cents, and that the following computation (provided the court disallows the deduction for income tax and bad debts) is that made by the complainant in the basis of the court's decree in the former case; and if the defendant differs in his views as to this computation, he will submit his computation to the court within four days.

Oct., 1872.

GEORGE HARDING,
Sol. for Compl't.
S. D. LAW, *Def't's Sol'r.*

1042

1043 *Quantity and value of sulphuric acid saved by R. G. Mitchell.*

The acid saved is calculated at 27 per cent. of the quantity of fat worked. Where the price of acid varies during the year, the total quantity worked is averaged among the number of working months reported, and the price of acid is taken as reported for the respective months.

Small fractions have been neglected, and the saving of acid has been charged on 7,420,740 lbs. of fat; being 6,779 lbs. less than reported.

From Jan'y 9, 1868, to July 10, 1868, the quantity of fat worked was 1,112,886 lbs., on which was saved 300,479 lbs. acid; during this whole period acid was 2¼ c'ts per pound, making	$7,511 97
From Sept. 28, 1868, to Aug. 31, 1869, 1,899,183 lbs. fat was worked, in 11 months, averaging 172,653 lbs. per month; price of acid from 1 Oct'r, '68, to 1 Apr., '69, (6 months,) was 3½ c ts per lb.; quantity of fat worked in those 6 months, 1,035,918 lbs.; acid saved, 279,697 lbs., at 3½ c'ts	9,789 39
In April & May, '69, fat worked, 345,306 lbs; acid saved, 93,192 lbs., at 3 c'ts	2,795 76
In June, '69, fat worked, 172,653 lbs.; acid saved, 46,596 lbs., at 2¾ c'ts	1,281 39
In July, '69, do. 172,653 do. 46,596, at 2½ c'ts	1,164 90
In Aug., '69, do. 172,653 do. 46,596, at 3 c'ts	1,397 88
From Sept. 1, 1869, to July 9, 1870, 2,193,267 lbs. fat was worked, in 10$^{3}/_{10}$ mos., averaging 212,937 lbs. per month: price of acid from Sept. 1, '69, to Jan. 1, '70, was 3 c'ts; fat worked in 4 months, 851,748 lbs; acid saved, 229,972 lbs., at 3 c'ts	6,899 16
During the whole year 1870 acid was 2½ c'ts; from 1 Jan'y to 9 July, '70, 6$^{3}/_{10}$ months, fat worked, 1,341,503 lbs.; acid saved, 362,205 lbs., at 2½ c'ts.	9,055 12
From Sept. 10, 1870, to July 24, 1871, 2,129,883 lbs. fat was worked in 10½ mos.; average, 202,846 lbs. per month: from Sept. 10, '70, to Jan 1, '71, acid was 2½ c'ts; fat worked in these 3¾ months, 743,768 lbs.; acid saved, 200,816 lbs., at 2½ c'ts	5,020 40
From Jan. 1, '71, to Apr. 1, '71, acid was 2¼ c'ts; fat worked in these 3 months, 608,538 lbs.; acid saved, 164,304 lbs., at 2¼ c'ts	3,696 84
From Apr. 1, '71, to Sept. 1, '71, acid was 2 c'ts; from Apr. 1, '71, to July 24, '71, in 3⅓ months, fat worked, 770,814 lbs.; acid saved, 208,116 lbs., at 2 c'ts	4,162 32
From Sept. 1 to Sep. 14, '71, fat worked, 92,300 lbs.; acid saved, 24,921 lbs., at 1¾ c'ts	436 11
Value of acids saved	$53,211 24

1044

1045 *Quantity and value of lime saved by R. G. Mitchell.*

	Fat worked.	Lime saved 13½ p. ct. of fat.	Lime bbl. of 215 lbs.	Price per bl.	Value of lime saved.
	lbs. fat.	*lbs.*			
1868. From Jan. 9 to July 10.....	1,112,886				
Fr Sept. 28 to Dec. 31, 3 mos., × 172,653 lbs.....	517,959				
	1,630,845	220,164	1,024	$1 75	$1,792 00
1869. 8 months, × 172,653 lbs.	1,381,224				
4 mos, × 212,937	851,748				
	2,232,972	301,451	1,402	1 67	2,341 34
1870. 6 3-10 months, × 212,937 lbs..	1,341,503				
3 2-3 months, × 202,846.....	743,768				
	2,085,271	281,512	1,309	1 52	1,989 68
1871. To July 24, 6 4-5 mos., × 202 846 lbs.....	1,379,352	186,213	866	1 47	1,273 02
" Sept. 1 to Sept. 14	92,300	12,460	57	1 47	83 79
	7,420,740 lbs.	1,001,800 lbs.			$7,479 83

1046

1047 *Quantity and value of fat saved by R. G. Mitchell. —Calculated at 2 per cent. of quantity worked.*

	Quantity of fat worked.	Quantity saved 2 per cent.	Cost per lb.	Value of fat saved.
	lbs.	*lbs.*	*cts.*	
From Jan. 9, 1868, to July 10, 1868.....	1,112,886	22,257	11½	$2,522 46
Sept. 28, 1868, to Aug. 31, 1869.....	1,899,183	37,983	12½	4,652 91
Sept. 1, 1869, to July 9, 1870.....	2,193,267	43,865	10½	4,605 82
Sept. 10, 1870, to July 24, 1871.....	2,129,883	42,597	9½	3,886 97
Sept. 1, 1871, to Sept. 14, 1871.....	92,300	1,846	9⅜	173 05
	7,427,519	148,548		$15,841 21

Increased profit from glycerine ⅓ cent per pound of fat worked.

	Amount rec'd for glycerine sold.	Quantity of fat worked.	Profit at 1·5 cent per lb.
		lbs.	
In 1868.....	$22,010 10	1,112,886	$2,225 77
" 1869.....	30,085 95	1,899,183	3,798 36
" 1870.....	17,531 36	2,193,267	4,386 53
" 1871.....	9,057 70	2,129,883	4,259 76
From Sept. 1 to 14, 1871.....		92,300	184 60
	$78,685,11	7,427,519	$14,855 02

1048

1049 *Value of acid, lime, and fat saved, and increased profit on glycerine.*

	FOR YEAR ENDING—				From Sep. 1 to Sep. 14, 1871.
	Aug. 31, 1868.	Aug. 31, 1869.	Aug. 31, 1870.	Aug. 31, 1871.	
Value of acid saved	$7,511 97	$16,429 32	$15,954 28	$12,879 56	$436 11
" lime "	1,792 00	2,241 34	1,989 68	1,273 02	83 79
" fat "	2,522 46	4,652 91	4,605 82	3,886 97	173 05
Increased profit on glyc	2,225 77	3,798 36	4,386 53	4,259 76	184 60
	$14,052 20	$27,221 93	$26,936 31	$22,299 31	$877 55

Summary and interest-account.

Interest is calculated from the end of each year (Aug. 31) on the amount of savings and profits accrued in the twelve months next preceding.

	Quantity of fat worked.	Value of lime, acid, and fat saved, and profit on glycerine.	Interest to Sep. 1, 1872.		
			Years.	Per cent.	
	lbs.				
For year ending Aug. 31, 1868	1,112,886	$14,052 20	4	28	$3,934 56
" " 1869	1,899,183	27,221 93	3	21	5,716 41
" " 1870	2,193,267	26,936 31	2	14	3,771 04
" " 1871	2,129,883	22,299 31	1	7	1,560 93
From Sep. 1 to Sep. 14, 1871	92,300	877 55			
lbs.	7,427,519	$91,387 30			$14,982 94

Principal amount	$91,387 30
Interest	14,982 94
Total	$106,370 24

1050 (Indorsed:) Complainant's estimated amount of profits.

1051 Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN }
vs.
ROLAND G. MITCHELL. }

SOUTHERN DISTRICT OF NEW YORK, *ss:*

Roland G. Mitchell, the above-named defendant, being duly sworn, says:

That the quantity of neutral fat treated by him in the Wright & Fouché apparatus, from the 9th day of January, 1868, to the 14th day of September, 1871, and the average cost thereof, is as follows:

From—	To—	Lbs.	Average cost.
January 9th, 1868	July 10th, 1868	1, 112, 886	11½
September 28, 1868	August 31, 1869	1, 899, 183	12½
September 1st, 1869	July 9th, 1870	2, 193, 267	10½
September 10th, 1870	July 24, 1871	2, 129, 883	9½
September 1st, 1871	September 14, 1871	92, 300	9½
		7, 427, 519	

That deponent is unable to furnish statement of purchases of such fats, month by month, as such material was not purchased during several months in the year; but that the above statement is correct as to the quantity of fat treated during the times above mentioned, and the average cost of the same.

1051 *a* That the quantity of glycerine sold by deponent, from January 9th, 1868, to September 14th, 1871, and the price for which the same was sold, was as follows; such sales, however, being on indefinite credit, interest being charg'able after three months:

Year.	No. lbs.	Cts per lb.
Sold in 1868	146, 734	15
" " 1869	200, 573	15
" " 1870	159, 376	11
" " 1871	29, 771	7⅞
" " 1871	75, 832	9
	612, 286	

That the prices paid by deponent for sulphuric acid, from January, 1868, to October, 1871, were as follows:

From January, 1868, to October, 1868..... 2½c. per lb.
From October, 1868, to April, 1869..... 3½c. " "
" April, 1869 " June, 1869..... 3c. " "
In June, 1869, " ..... 2⅜c. " "
" July, 1869..... 2½c. " "
From August, 1869, to January, 1870..... 3c. " "
" January, 1870, " January, 1871..... 2½c. " "
" January, 1871, " April, 1871..... 2¼c " "
" April, 1871, " September, 1871..... 2c. " "
" Septemper, 1871," ..... 1¾c. " "

1051*b* And that the average price of Glen Falls lime, from 1868 to 1871, was as follows:

In 1868..... $1. 75 per lb.
" 1869..... 1. 67 " "
" 1870..... 1. 52 " "
" 1871..... 1. 47 " "

Deponent further says that the treating of such fats, and the manufacture of articles therefrom, has been the only business carried on by deponent during such time, from January, 1868, to October, 1871; that under the internal revenue laws, there was paid income tax, arising from the profits derived from the said business, as follows:

For 1868	$1,213 05
" 1869	2,380 05
" 1870	710 48
" 1871	494 90
	$4,798 48

Deponent further says, that the losses in said business, by bad debts during such period, from January, 1868, to October, 1871, amounted to the sum of $3,964.94, without computation of interest thereon.

R. G. MITCHELL.

1052 Subscribed and sworn to before me this 10th day of September, A. D. 1872.

[SEAL.]

A. T. GURLITZ,
Notary Public, Kings Co., New York.

(Indorsed:) Circuit court of the United States, southern district of New York. Richard A. Tilghman vs. Roland G. Mitchell. Copy affidavit of R. G. Mitchell, as to cost of fats, etc.

1053 RICHARD A. TILGHMAN *vs.* ROLAND G. MITCHELL. } No. 2.

This cause came on to be heard in pursuance of the order heretofore made May 31, 1872, and the said plaintiff having been heard by George Harding, and the defendant by Charles M. Keller and S. D. Law, esq., it is ordered, adjudged, and decreed that the plaintiff do recover of the defendant the sum of one hundred and six thousand three hundred and seventy dollars and twenty-four cents as profits, and fifty-three dollars and twenty cents as costs, making in all one hundred and six thousand four hundred and twenty-three dollars and forty-four cents, this first day of September, 1872.

SAM'L BLATCHFORD.

(Endorsed:) U. S. C. C., S. D. N. Y. Richard A. Tilghman vs. Roland G. Mitchell, No. 2. Decree filed Oct. 22, 1872.

1054

1055 At a stated term of the circuit court of the United States of America for the southern district of New York, in the second circuit, held at the United States court-rooms in the city of New York, on the day of , in the year of our Lord one thousand eight hundred and seventy—

Present, the honorable Samuel Blatchford, dist. judge.

RICHARD A. TILGHMAN *vs.* ROLAND G. MITCHELL. } No. 2.

This cause came on to be heard in pursuance of the order heretofore made, May 21, 1872, and the said plaintiff having been heard by George Harding, and the defendant by Charles M. Keller and S. D. Law, esq., it is ordered, adjudged, and decreed that the plaintiff do re-

cover of the defendant the sum of one hundred and six thousand
1056 three hundred and seventy dollars and twenty-four cents as profits, which sum is made up from estimated savings of lime, sulphuric acid, and fats, and increased profit from glycerine sold, amounting, together, to ninety-one thousand three hundred and eighty-seven dollars and thirty cents, and interest allowed on such savings from and after the close of each year, on the ascertained value of the savings and profits for the twelve months next preceding, and amounting to fourteen thousand nine hundred and eighty-two dollars and ninety-four cents, and fifty-three dollars and twenty cents costs, making, in all, one hundred and six thousand four hundred and twenty-three dollars and forty-five cents, this first day of September, 1872.

SAMUEL BLATCHFORD.

It is hereby consented that the above supplemental decree may be entered in the above cause as of the 22d day of Oct., 1872.

Dated Nov. 27, 1872.

1057 S. D. LAW, *Sol. for Def't.*
GEORGE HARDING,
Sol. for Compl't.

(Endorsed:) Circuit court of the United States, south'n dist. of New York. R. A. Tilghman vs. R. G. Mitchell. No. 2. Supplemental decree.

Enter within order nunc pro tunc as of October 22d, 1872.

Dated November 30, 1872.

SAM'L BLATCHFORD.

Filed Dec. 2, 1872.

1058.

1059 RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

To the honorable the Supreme Court of the United States:

The appeal of Roland G. Mitchell, the above-named defendant, respectfully sheweth:

That, on or about the eighth day of March, one thousand eight hundred and seventy-one, the above-named complainant filed his bill of complaint in this suit, in the circuit court of the United States for the second circuit and southern district of New York, against the above-named defendant, praying an injunction against the said defendant, restraining him from using a certain alleged "improvement in processes for purifying fatty bodies," alleged in the said complaint to have been patented to the said complainant on the third day of October, 1854, and antedated to the ninth day of January, 1854, and extended on the twenty-third day of November, 1867, for the term of seven years from the ninth day of January, 1868, and that said defendant should account
for and pay over the income thus unlawfully derived from the
1060 violation of the alleged rights of said complainant, and for such other relief as the equity of the case should require, and to said court might seem meet.

That your petitioner duly filed his answer to the said bill of complaint,

and such proceedings were had that, on the 31st day of May, 1872, a decree was made and rendered therein by the said circuit court in the following words:

"At a stated term of the circuit court of the United States of America for the southern district of New York, in the second circuit, held at the United States court-rooms, in the city of New York, on the 29th day of May, in the year of our Lord one thousand eight hundred and seventy-two—

"Present, the honorable Samuel Blatchford, dist. judge.

"RICHARD A. TILGHMAN
"*vs.*
"ROLAND G. MITCHELL. } Suit No. 2. On extended term of patent.

"This cause having been brought to a final hearing upon the pleadings and proofs, and the counsel for the defendant having, in view of the decision made in a case in this court, under the same patent, be-
1061 tween the same parties, brought on the patent before it was extended, waived formal argument, it is hereby ordered, adjudged, and decreed that the letters-patent No. 11786, granted unto the said Richard A. Tilghman on the third day of October, 1854, is a good and valid patent, and that the said Richard A. Tilghman was the original and first inventor of the improvement described and claimed in the said patent, and that the said patent was legally and duly extended on the 23rd day of November, 1867, for the term of seven years from the 9th day of January, 1868, and that the said defendant has infringed upon the said patent, and upon the exclusive rights of the complainant, during the extended term of said patent.

"And it is further ordered, adjudged, and decreed that the plaintiff do recover from the defendant the profits and gains which the said defendant has made or received, or which have arisen or accrued to him from said infringement of the said patent by the use of the said improvement described and secured by the said letters-patent, at any and all times after the ninth day of January, A. D. 1868, down to the 14th of September, A. D. 1871.

"And it is further ordered, adjudged, and decreed that the said plaintiff do recover of the defendant his costs and charges in this suit to be taxed.

1062 "And it is further ordered and adjudged and decreed that a perpetual injunction be granted in this suit against the said defendant, according to the prayer of the bill; and that the issue of the writ of injunction be suspended during the payment of the license-fees or royalty stipulated to be paid by said defendant to said plaintiff.

"And it is further ordered that the reference to the master to ascertain the gain and profits hereinbefore decreed having been waived by both parties, the same is reserved for the further hearing of this court.

"SAM'L BLATCHFORD.

"(Endorsed:) Filed May 31, 1872."

Which said decree of the said circuit court is, as this appellant is advised, erroneous, and ought to be reversed.

That, under said decree, proceedings were had by the said court, as therein provided for; and that, on the twenty-second day of October,

1872, a decree was made and rendered as to the alleged gains and profits made by defendant, in the following words:

1063 "RICHARD A. TILGHMAN
"*vs.*
"ROLAND G. MITCHELL. } No. 2.

"This cause came on to be heard in pursuance of the order heretofore made, May 31st, 1872, and the said plaintiff having been heard by George Harding, and the defendant by Charles M. Keller and S. D. Law, esq'r.:

"It is ordered, adjudged, and decreed that the plaintiff do recover of the defendant the sum of one hundred and six thousand three hundred and seventy dollars and twenty-four cents as profits, and fifty-three dollars and twenty cents, costs, making in all one hundred six thousand four hundred and twenty-three dollars and forty-four cents, this first day of September, 1872.

(Signed) "SAM'L BLATCHFORD.

("Endorsed:) Filed Oct. 22, 1872."

1064 Which said decree of the said circuit court is, as this appellant is advised, erroneous, and ought to be reversed.

Wherefore this defendant appeals from the whole and every part of each and every of the said decrees of the said circuit court to the Supreme Court of the United States, and respectfully prays that the said decrees of the said court, and the complaint, answer, pleadings, depositions, evidence, and proceedings in the said cause may be sent to the Supreme Court of the United States; and that the said Supreme Court will proceed to hear the said cause anew; and that the said decrees of the circuit court and every part thereof may be reversed, and a decree made dismissing the said complaint with costs, or such other decree as to the said Supreme Court shall seem just.

Dated New York, Oct. 31st, 1872.

R. G. MITCHELL.

S. D. LAW,
Def't's Sol'r.

(Endorsed:) Richard A. Tilghman vs. Roland G. Mitchell. Appeal filed November 1st, 1872.

1065 Circuit court of the United States, southern district of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

Know all men by these present' that we, Roland G. Mitchell, Jethro Mitchell, and Henry P. Mitchell, are held and firmly bound unto Richard A. Tilghman in the sum of two hundred and thirteen thousand dollars, to be paid to the said Richard A. Tilghman, his executers, administrators, and assigns; for the payment of which, well and truly to be made, we bind ourselves, our and each of our heirs, executors, and administrators, jointly and severally, firmly by these

J. A. S.

present', sealed with our seals, and dated the thirty-first day of October, one thousand eight hundred and seventy-two.

Whereas the above-named Roland G. Mitchell has prosecuted an appeal to the Supreme Court of the United States, out of this court, to reverse the judgment and decree rendered in the above-entitled suit, and entered with the clerk of this court, at the city of New York,
1066 on the thirty-first day of May, 1872, by which decree it was adjudged that the defendant had infringed upon and violated the patent-right of the complainant mentioned in the bill of complaint, and was further ordered that the complainant do receive from the defendant the profits and gains which the said defendant had made or received, or which had arisen or accrued to him from said infringement, with the costs, charges, & disbursements of said complainant in said suit to be taxed; and also to reverse the order or decree of the said circuit court made and entered herein, on the twenty-second day of October, 1872, adjudging and decreeing that the defendant, Roland G. Mitchell, pay the complainant the sum of one hundred and six thousand three hundred & seventy $\frac{24}{100}$ dollars damages, besides the complainant's costs, taxed at the sum of fifty-three and $\frac{20}{100}$ dollars, making in the whole the sum of one hundred & six thousand four hundred & twenty-three dollars and forty-four cents:

Now, therefore, the condition of this obligation is such, that if the above-named Roland G. Mitchell shall prosecute his said appeal
1067 to effect, and shall pay the several sums awarded by the said order and decree, and answer all damages and costs, if the said decree shall be affirmed, then this obligation to be void; otherwise, to be and remain in full force & virtue.

R. G. MITCHELL. [L. S.]
JETHRO MITCHELL. [L. S.]
HENRY P. MITCHELL. [L. S.]

In the presence of—
JOHN A. SHIELDS.

SOUTHERN DISTRICT OF NEW YORK,
City of New York, ss:

On this 31st day of October, 1872, before me personally came Roland G. Mitchell, Jethro Mitchell, and Henry P. Mitchell, to me known to be the persons described in and who executed the foregoing instrument, and severally acknowledged that they executed the same for the purpose therein mentioned.

JOHN A. SHIELDS,
U. S. Commissioner S. D. N. Y.

SOUTHERN DISTRICT OF NEW YORK,
City & County of New York, ss:

On this 31st day of October, 1872, before me personally came Henry P. Mitchell, of No. 78 West 11th st., and, being duly sworn, deposes
1068 and says that he resides in the said city of New York, and State of New York, is a free-holder in said State, and is worth the sum of one hundred thousand dollars over & above all his liabilities, exclusive of property exempt from execution.

HENRY P. MITCHELL.

Sworn to before me this 31 day of October, 1872.

JOHN A SHIELDS,
U. S. Commissioner S. D. of N. Y.

SOUTHERN DISTRICT OF NEW YORK,
City & County of New York, ss:

On this 31st day of October, 1872, before me personally came Jethro Mitchell, and being duly sworn, deposes and says that he resides in the city of Cincinnati, State of Ohio, and that he is worth the sum of one hundred and thirteen thousand dollars over and above his just debts and liabilities, exclusive of property exempt from execution.

J. A. S.

JETHRO MITCHELL.

Sworn to before me this 31st day of October, 1872.

JOHN A. SHIELDS,
U. S. Commissioner S. D. of N. Y.

The foregoing bond is approved as to form and amount & the sufficiency of the sureties.
Dated October 31, 1872.

SAM'L BLATCHFORD, *D. J.*

1069

1070

(Indorsed:) Richard A. Tilghman vs. Roland G. Mitchell. Bond on appeal. Filed Nov. 1st, 1872.

1071 By the honorable Samuel Blatchford, one of the judges of the circuit court of the United States for the southern district of New York, second circuit.

TO RICHARD A. TILGHMAN:

Whereas Roland G. Mitchell has lately appealed to the Supreme Court of the United States from a decree rendered by the circuit court of the United States for the southern district of New York, second circuit, on the thirty-first day of May, 1872, and from the order or decree founded thereon, made and entered on the twenty-second day of October, 1872, directing the payment by him, said Mitchell, of the damages and costs, amounting to one hundred six thousand four hundred and twenty-three dollars and forty-four cents, decreed to have been sustained by you in a suit wherein you are complainant and said Mitchell is defendant, for the alleged infringement and violation of certain
1072 letters-patent claimed by you, mentioned in the pleadings in said suit, and the said Roland G. Mitchell has filed the security required by law upon his said appeal:

You are, therefore, cited to appear before the Supreme Court of the United States on the first Monday of December next, and show cause, if any there be, why the decrees and orders named in the aforesaid appeal should not be corrected and speedy justice should not be done to the parties in that behalf, and to do and receive what may appertain to justice to be done in the premises.

Given under my hand at the city of New York, in the southern district of New York, in the second circuit, the thirty-first day of October, one thousand eight hundred and seventy-two, and of the Indepen'ce of the United States the ninety-seventh.

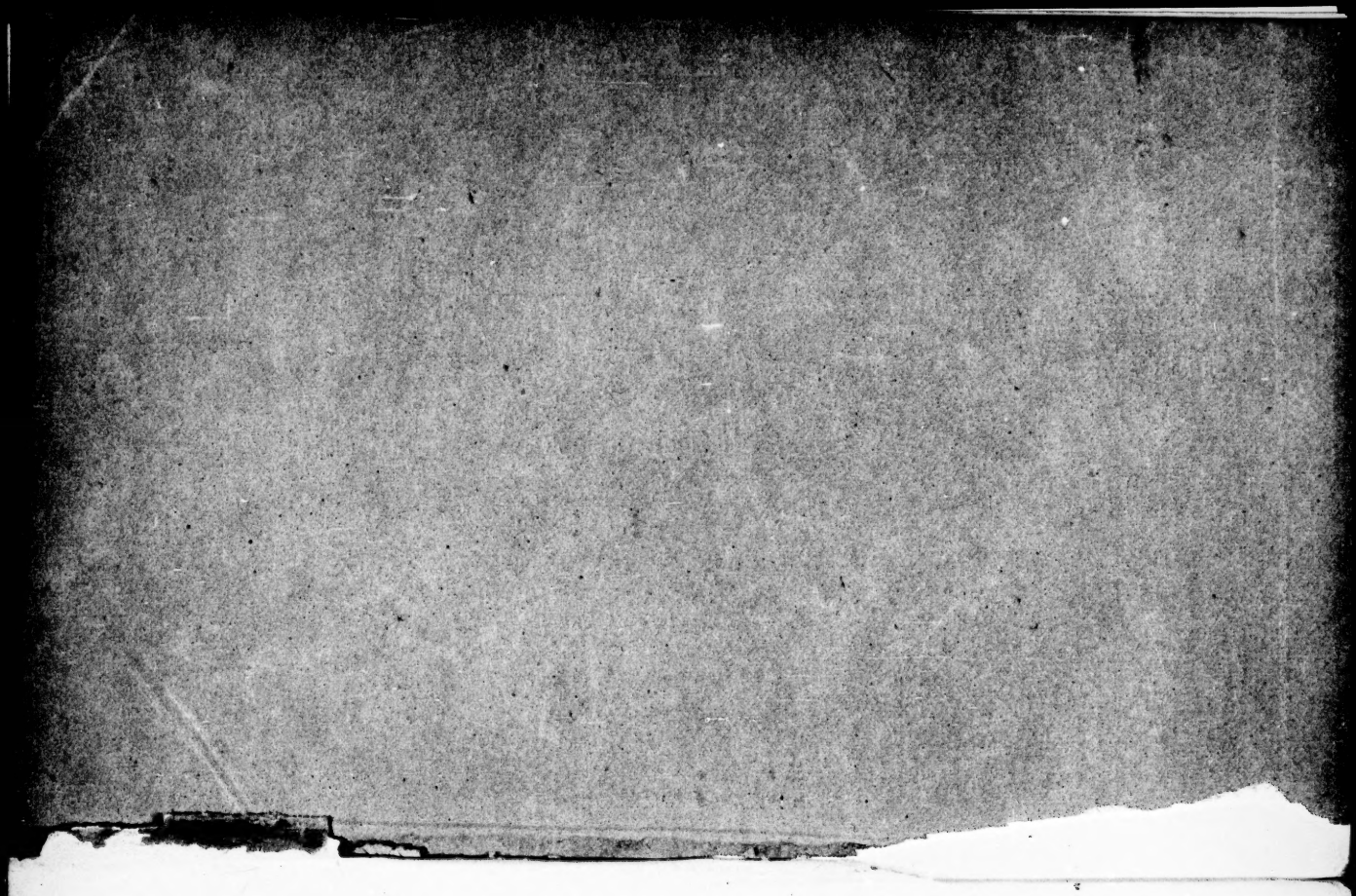
SAM'L BLATCHFORD.

1073 Notice of citation accepted.
November 2, 1872.

GEORGE HARDING,
Solicitor for R. A. Tilghman.

(Endorsed:) Richard A. Tilghman vs. Roland G. Mitchell. Citation. Filed Nov. 4, '72.

(Indorsement on cover:) No. 340. Roland G. Mitchell, appellant, vs. Richard A. Tilghman. S. New York C. C. U. S. Filed 7th December, 1872.



Supreme Court

OF THE UNITED STATES.

No. 589.

ROLAND G. MITCHELL,

Appellant,

versus

RICHARD A. TILGHMAN,

Appellee.

Appellant's Brief.

KELLER & BLAKE,
WM. M. EVARTS,
Of Counsel for Appellant.

NEW YORK:
DAVIS & CORSON, PRINTERS, 30 NASSAU STREET.
1873.

Brief Supp 246, 24

Supreme Court of the United States.

No. 539.

ROLAND G. MITCHELL,
Appellant,

vs.

RICHARD A. TILGHMAN,
Appellee.

STATEMENT OF THE CASE AND POINTS ON THE PART OF THE APPELLANT.

This is a suit under Letters Patent granted to Richard A. Tilghman, dated October 3d, 1854, and ante-dated January 9, 1854, for "Improvement in Processes for Purifying Fatty Bodies." (Record pp. 3–7.)

There was a decree in the Court below sustaining the validity of the patent and holding the appellant to have infringed, and ordering an injunction and a reference on accounting to Kenneth G. White, as Master, appellant being left at liberty to stay the injunction until final hearing on filing a bond in the penal sum of twenty thousand dollars, with a condition to pay the award on final decree in the Court below, or in the Supreme Court on appeal. (Record, p. 261.)

The bond was filed and the injunction stayed. (See written matter at the end of printed record.)

Supreme Court of the United States.

No. 539.

ROLAND G. MITCHELL,
Appellant,

vs.

RICHARD A. TILGHMAN,
Appellee.

STATEMENT OF THE CASE AND POINTS ON THE PART OF THE APPELLANT.

This is a suit under Letters Patent granted to Richard A. Tilghman, dated October 3d, 1854, and ante-dated January 9, 1854, for "Improvement in Processes for Purifying Fatty Bodies." (Record pp. 3–7.)

There was a decree in the Court below sustaining the validity of the patent and holding the appellant to have infringed, and ordering an injunction and a reference on accounting to Kenneth G. White, as Master, appellant being left at liberty to stay the injunction until final hearing on filing a bond in the penal sum of twenty thousand dollars, with a condition to pay the award on final decree in the Court below, or in the Supreme Court on appeal. (Record, p. 261.)

The bond was filed and the injunction stayed. (See written matter at the end of printed record.)

The opinion of the Court below will be found. (Record, pp. 98–101.)

The Master reported that no gains or profits had been proved to have been received by, or to have arisen or accrued to the respondent from the use of the invention patented in the Letters Patent set forth in the order of reference. (Record, p. 408.)

On exceptions to the Master's report, the Court decreed that the complainant do recover of the respondent, as profits, the sum of..... $229,826 63
And as costs..... 954 98

Making, in all..... $230,781 61
(Record, p. 412.)

And, by consent, after the filing and printing of the appeal record, an amended decree was made and filed, which will be found in writing at the end of the printed record.

The amount in the amended decree is the same as in the first, but it is therein specified that the sum of $229,826.63 is made up of $160,699.05 as savings of lime, sulphuric acid and fat, and increased profit from glycerine sold: and $69,127.58 for interest on each year: and $954.98 for costs.

It was stipulated that the following facts should have the same effect as if they appeared in proof in the record:

1*st*. That on the 13th of December, 1864, the respondent filed the bond in the penal sum of twenty thousand dollars before referred to.

2*d*. That upon the filing of said bond the injunction was suspended.

3*d*. That the respondent continued to use and work the same process down to the 9th day of January, 1868, the date of the expiration of the original term of the

patent. (*See written matter at the end of the printed record.*)

THE ERRORS IN THE DECRETAL ORDERS from which appellant prays redress in this Court are:

First. That the patent at issue is a good and valid patent under the construction of the claim of the patent stated in the opinion of the Court. (*Record, p.* 98.)

Second. That appellant has infringed the said patent.

Third. That the complainant do recover of the respondent, as profits, gains or savings..... $160,699 05
And as interest computed on the savings for each year..... 69,127 58
And as costs..... 954 98

Making in all..... $230,781 61
(Record, p. 251 and written matter at the end of record.)

The suit was instituted under Letters Patent of the United States, granted to Richard A. Tilghman, dated October 3d, 1854, and ante-dated January 9, 1854, entitled, *in the patent*, for "Improvement in processes for purifying fatty bodies," and *in the specification*, for "a new and improved mode of treating fatty and oily bodies of animal and vegetable origin." (Record, pp. 4 to 7.)

Before passing to the argument, it is deemed advisable to give a clear and full statement of the process and apparatus as described in the patent at issue, and of the process and apparatus used by appellant, and found by the Court below to be an infringement.

FIRST.

Of the process and apparatus in which it is to be worked, as described in the patent at issue.

The patentee, in his specification, says: "My invention consists of a process for producing free fatty acids and solution of glycerine from those fatty and oily bodies

which contain glycerine as their base. For this purpose I subject these fatty or oily bodies to the action of water at *a high temperature and pressure*, so as to cause the elements of those bodies to combine with water, and thereby obtain, at the same time, free fat acids, and solution of glycerine."

Having thus stated what is to be treated, and what is to be produced, the patentee proceeds to describe the process of treatment, as the means invented, by which the stated result is to be obtained, and to that end he says: "I *mix* the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in *any convenient vessel in which it can be heated to the melting point of lead* until the operation is complete. The vessel must be *closed* and *of great strength*, so that the requisite *amount of pressure* may be applied *to prevent the conversion of the water into steam.*"

This is a clear and distinct statement of the process invented for "producing free fatty acids and solution of glycerine from the fatty or oily bodies which contain *glycerine* as their base."

There are three requisites to the fulfillment of this process as defined by the patentee, viz: *First:* The *admixture of the fatty or oily body* to be treated with from one-third to one half its bulk of water. *Second:* Subjecting this admixture in a *convenient vessel in which it can be heated to the melting point of lead* until the operation is complete; and *Third:* the vessel in which this mixture is to be *heated* to the *melting point of lead*, must be *closed* and of *great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.*

So far the patentee has not detailed the structure of the vessel in which the process is to be worked, except by the phrase, "*any convenient vessel*," but as the heating of a liquid in a close vessel to the temperature of the melting point of lead, which is from 610 to 620° Fahrenheit, and

this develops a pressure not far below 2,000 pounds to the square inch.

In view of the obvious difficulties, the patentee then proceeds to describe a specific apparatus in which and by which the conditions specified are to be carried out. He says: "The process may be performed more rapidly, and also continuously, by causing the mixture of fat and water to pass through a tube or continuous channel, *heated to the temperature already mentioned;*" (melting point of lead), "*the requisite pressure for preventing the conversion of water into steam being applied during the process, and this, I believe, is the best mode of carrying my invention into effect.*" And then, by reference to accompanying drawings, he gives a specific description of an apparatus which, in the testimony, is termed the *coil of tubes.* It consists of a tube of half an inch internal and one inch external diameter, and of considerable length, bent up and down in a coil, and enclosed in a mass of solid cast iron. This coil is placed over a suitable furnace; the melted fat and water are mixed in a churn-like apparatus, and by a pump forced through this pipe at such a rate that any one portion of it will travel through the whole length of heated pipe in the space of ten minutes, and at the end it passes into a cooler and escapes through a valve loaded so as to present a resistance of 2,000 pounds to the square inch: and it is stated that the load on this valve must be such that when the pump is not in action no portion of the contents shall be permitted to escape. The patentee states: "No steam or air *should be permitted to accumulate in the tubes, which should be kept entirely full of the mixture.*"

And as to the temperature to which the mixture of fat and water should be exposed, the patentee says: "The melting point of lead has been mentioned *as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matter into fatty acids and glycerine takes place with some materials* (such as palm oil) at or below the *melting point of bismuth*" (510° Fahr.). "Yet the heat has been carried con-

siderably above the melting point of lead" (610° to 620° Fahr.) "without any apparent injury."

The apparatus is provided with holes made in the solid metal surrounding the coiled pipe to contain fusible metals, to indicate the temperature to which the coil of pipes shall be heated; and the patentee says: "The series which I have used consists of *tin* melting at about 440° Fahr.; *bismuth* at about 510° Fahr.; *lead* at about 610° Fahr., and *nitrate of potash* at about 660° Fahr." Such are the ranges of heat given; and the patent states that the range of heat at which the change to be produced takes place, varies, according to the kinds of fat to be treated, from the *melting point of bismuth* (510° Fahr.) to the *melting point of lead* (*about* 610° to 620° Fahr.) (Record, pp. 4–7.)

SECOND.

Of the process practiced by the Respondent and found by the Court below to be an infringement of the patent at issue.

This process is worked in an apparatus consisting of a large vertical vessel two feet in diameter and twelve feet in height, to contain the fat to be treated. By the side of it and below there is a boiler of about half the size. A pipe extends from the upper part of the boiler to the upper part of the vessel containing the fat, and above the charge of fat; and the lower part of the vessel containing the fat is in turn connected with the boiler by a pipe which extends to near the bottom of the latter. The fat to be treated is charged in the upper vessel to within about two feet of the top, and the boiler is filled with water. The boiler is placed on a furnace to heat the water in it to the temperature of about 370 Fahr.—equal to a pressure of 180 pounds to the square inch. As the vessel containing the fat is not filled, the space at the upper end (about one-third the entire capacity of the vessel) must, of necessity, be always full of steam. By the heat applied to the boiler, steam and bubbles of water will rise through the pipe at the top and will be discharged

above the fat in the vessel, and circulate through the charge of fat and run back into the boiler. In this way a constant circulation of water is carried on through the charge of fat, the glycerine, as fast as it is formed, being carried off into the boiler below instead of remaining in admixture with the remaining fat where it would impede the further chemical action required for the decomposition and union of the elements of the fat with the elements of water.

Such is the process and apparatus which was held by the Court below to infringe the patent at issue. See testimony of

Florence Verdin (Record D, Ints. 40–45, p. 146.)
Roland G. Mitchell (Record D, Int. 4, p. 352.)

The process and apparatus, so used by appellant, was patented by Wright and Fouché in France, in 1857, and in the United States, January 25th, 1859, and the right to work under this patent was purchased by appellant. (Record, pp. 229 to 233.)

As the questions of fact to be determined, particularly with reference to their bearing on the legal construction of the claim in the patent at issue and the question of infringement, relate to chemistry, it is deemed important to state and explain them as briefly as clearness will permit.

1st. The chemical constitution of fatty and oily bodies of animal and vegetable origin.

2d. The chemical constitution of water and of its chemical and physical properties as a liquid; as saturated steam; and as superheated steam.

3d. The chemical rationale of the decomposition of fats and oils of animal and vegetable origin, and of the union of their elements with other elements for the production of what are termed fatty acids and glycerine.

4th. A description of the processes for decomposing fats and oils which were in general use before the date of the patent at issue, and which have continued in use to the present time.

FIRST.

Of the chemical constitution of fatty and oily bodies of animal and vegetable origin.

The fatty and oily bodies are each composed of stearine, margarine and olein combined with the oxide of lypil or glyceril as their base. These ingredients are united and held together by chemical affinity. The object of the processes under consideration, and of other previously known processes, is, not only to decompose such compound substances, but—at the same time that the affinities by which they are united are overcome—to have some chemical agent or agents present to combine with its elements to produce fatty acids and glycerine.

SECOND.

Of the chemical constitution of water, and of its chemical and physical properties in the three conditions, viz.: as a liquid; as saturated steam; and as superheated steam.

Water is composed of oxygen and hydrogen, in the proportion, by weight, of 88.9 oxygen to 11.1 of hydrogen. Separately, these are permanent gases, but, when chemically combined, produce water in the liquid form. Its chemical properties are—by its oxygen to acidify, and by its hydrogen to hydrate.

Water in the liquid state expands by increase of temperature, and contracts by reduction of temperature, until it approaches the freezing point, when it expands, that, when frozen, it may float on the surface, and, by its non-conducting properties, protect the water below from the freezing action of the cold atmosphere.

When heated up to the temperature of 212° Fahr., at the pressure of the atmosphere, which is fifteen pounds to the square inch, it is expanded into steam, each cubic foot producing seventeen hundred cubic feet of steam, and when confined under the pressure of two atmos-

pheres, or thirty pounds to the square inch, each cubic foot of water will produce but 850 cubic feet of steam; and so on, as the pressure is increased, the volume of steam produced will be reduced, and its density and elastic force increased. And the pressure may be so increased, that the density of the steam will become nearly equal to that of water. No matter at what high temperature and pressure saturated steam may be generated, the moment it is liberated into the atmosphere, it instantly expands to 1,700 times the bulk of water from which it was generated, and, in so expanding, it is instantly reduced in temperature to 212° Fahr., the sensible heat above that becoming latent.

Steam generated from water, by the application of heat to the water, is termed "saturated steam," and sometimes, by the ignorant, "wet steam." But when heat is applied directly to saturated, that is, to steam which has been generated by the application of heat to the water, it is then termed "superheated steam," and, by the ignorant, "dry steam," and its expansion, by change of temperature, is then governed by the same law as atmospheric air. In a vessel open to the atmosphere, superheated steam may be heated to any temperature, just like atmospheric air, the increased bulk due to the expansion by increased heat escaping into the open air, where it is condensed, after falling to the temperature of 212° Fahr.

But, whether saturated or superheated, steam has the same chemical constitution as water, for its two ingredients are still combined in precisely the same proportions and by the same affinity, although weakened in the state of expansion, and therefore in a better condition to decompose, when its ingredients are required to separate, so as to unite by other affinities with other bodies.

Steam, whether saturated or superheated, is as invisible as atmospheric air, and the one is just as dry as the other; but in either condition, when reduced (in temperature) a mere fraction below 212° Fahr., will begin to

condense, and thereby become wet, because it is then passing into the liquid form by loss of heat.

Persons ignorant of the properties of steam, when they see steam issuing from a pipe, fancy that it is steam which they see; but that is an error. What they see is the film of water produced by the condensing action of the surrounding air. And why saturated steam is sometimes termed wet steam, and superheated steam dry steam, is also the result of ignorance. As saturated steam of any temperature, when liberated from the pressure under which it was generated, is instantly reduced in temperature to 212° F. by expansion, it follows that if it comes into contact, say with the human hand, or any other surface which is at a much lower temperature, it is instantly condensed to the form of water, and that moisture which is thus seen or felt, is water and not steam. But when steam which has been superheated comes into contact with the human hand, or any other surface of less temperature, it will not be condensed to the condition of water by such contact, until its sensible heat is reduced to 212° F., and then, and only then, will it begin to condense.

It will be seen, from the foregoing, that no matter at what temperature saturated steam has been generated, the instant it is liberated into the atmosphere it expands, and by that expansion loses all its sensible heat above 212° F., which is taken up in the expansion, and becomes, as it is termed, latent. And that with superheated steam all the heat which is applied to it to change it from saturated steam to superheated steam, is sensible heat, which is not rendered latent by a sudden expansion, but must be absorbed by the atmosphere or surfaces with which it comes into contact, just as in the case of highly heated atmospheric air.

THIRD.

Of the chemical rationale of the decomposition of fats and oils of animal and vegetable origin, and of the

union of their elements with other elements for the production of what are termed fatty acids and glycerine.

The elements or constituents of a fat or oil are united and held together by chemical affinity. Heat alone will overcome the affinity by which they are united. The temperature at which this decomposition is effected by heat alone, differs with different qualities of fat or oil from about 510° F. (the melting point of bismuth), to 610° F. (the melting point of lead), which are the very temperatures named as required in the process described in the patent at issue; but the decomposition effected by heat alone will not produce fatty acids and glycerine.

The three fatty acids required to be obtained are stearate, margarate and oleate; that is, stearin chemically combined with an acidifying base, and so with the other two. These three substances in the fat are combined with the oxide of glyceril as a base, and when the decomposition is effected under the influence of heat, chemical agents must be present which can take the place of the oxide of glyceril to acidify the stearin, the margarin and the olein, and change them into the oxides of stearin, of margarin, and of olein. And at the same time some chemical agent must be present to take the place of the ingredients, which were combined with the oxide of glyceril to produce glycerine.

To produce glycerine from the decomposition of fats, water or its equivalent, must be present to hydrate the glyceril, and in all processes which have been practiced, water has always been present for that purpose. And to produce the three fatty acids, there must be present three equivalents of a base to take the place of the oxide of glyceril, which was the base, but which is separated by the act of decomposition. These three equivalents of base may be lime, soda, potash, water, or almost any other oxide. Lime is an oxide of calcium, as soda, potash and water are oxides; water being an oxide of hydrogen. Unless such equivalents are present to oxidize the stearin, the margarin and the olein, they cannot

be obtained from the decomposition of fats and oils as fat acids; and unless water or its elements be present, it is impossible to obtain glycerine.

The term "saponification," in the general sense, consists in furnishing three equivalents of water for the three of acid to form glycerine, and in furnishing to the stearin, margarin and olein three equivalents of an acidifying base as a substitute for the three of oxide of glyceril removed to form the three fatty acids. (Record, pp. .)

FOURTH.

Description of the process for decomposing fats and oils, which was generally used before the date of the patent at issue, and which has continued to be used to the present time.

It is termed specially the saponifying process. A hundred pounds of fat and twenty-five pounds of water are put in a boiler;—and in another vessel, from twelve to fourteen pounds of lime, slaked in sixty-six pounds of water, and then poured into the vat containing the fat, and there the whole is boiled at the pressure of the atmosphere for about eight hours. After settling, the water containing the glycerine is drawn off, leaving in the boiler what is termed lime-soap, which is afterwards treated with sulphuric acid, to remove the alkali and produce free fat acids.

The rationale of this process is readily understood. Under the action of the heat, the stearin, margarin and olein leave the glyceril to combine with the lime, which is an oxide of calcium, because of their greater affinity for it than for the oxide of glyceril, which, being thus liberated, combines with the elements of water, forming glycerine, which remains in solution in the remaining water. This is drawn off, and the surplus water evaporated. What remains in the boiler are the fatty acids which have combined with the lime, and are termed in the trade, lime-soap. The lime (oxide of calcium), having

replaced the oxide of glyceril by reason of its greater affinity, and as this lime-soap is composed of fatty acids and an alkali, the latter must be removed by treating this compound with sulphuric acid, which, by its greater affinity, combines with the alkali, leaving the free fatty acids. Almost any other oxide could be substituted for the lime. (Record, pp. 143, 246, 247, 352.)

The questions to be determined are:

1st. What is the true legal construction of the patent at issue?

2d. Is it a good and valid patent?

3d. Has the appellant infringed the said patent?

4th. And if this Court shall hold the patent at issue to be valid, and appellant to have infringed, then are any of the profits, gains or savings realized by appellant due to the use of the invention described and claimed in the patent at issue?

POINT I.

WHAT IS THE TRUE LEGAL CONSTRUCTION OF THE PATENT AT ISSUE?

On this question the Court below erred in assuming the following as facts proved:

First.—That Tilghman, the patentee, is the original and first discoverer of the chemical fact that water at a high temperature will decompose fatty and oily bodies, and produce therefrom fatty acids and solution of glycerine.

Second.—That the description of the working of the process, in the patent at issue, does not require the vessel in which the process is to be worked to be full and main-

tained entirely full of the emulsion or mixture of fat and water, so that steam shall not be formed in the said vessel during the working of the process.

Third.—That the description in the patent at issue is not limited to the working of the process at the range of temperature specified in the patent.

Fourth.—That the description in the patent at issue does not require that the fat and water shall be maintained in a state of admixture, but includes the circulation of the water through the fat under treatment.

Fifth.—That fats and oil can be practically and successfully decomposed, and fatty acids and glycerine produced therefrom, by the means described in the patent at issue.

It will be contended, on the part of appellant, that the evidence does not justify such findings, but the reverse.

The process described in the patent at issue by the terms of the specification is limited to four conditions:

(*a.*) The use of water in the liquid state, and no other.

(*b.*) The mixture of fat and water for effecting the decomposition to be subjected to a temperature ranging from 510° to 610 F., according to the quality of the fat, such being the temperatures by which heat alone will decompose fats.

(*c.*) The process to be worked in a vessel of great strength; to be entirely filled with the emulsion or mixture of fat and water, so that steam shall not be formed.

(*d.*) The water and fat to be thoroughly mixed before, and maintained in such state of admixture during the working of the process.

As matter of law, we submit that Letters Patent are to be construed according to the true import of the terms used, aided by the state of the art known before and at

the time of the grant, but that the terms cannot be enlarged by developments in science and art subsequent to the grant of the patent.

A patentee, in drafting his specification, may be presumed to be influenced by the state of the art then known, but it cannot be presumed that he was influenced by what was not then known.

The following facts are proved in the record to have been known in the arts prior to 1854 :

1. That heat alone will decompose fats and oils at the range of temperatures specified in the patent at issue, but that heat alone will not resolve their elements into fatty acids and glycerine.

2. That liquids can be heated to temperatures even beyond the highest named in the patent in a vessel entirely full, so that steam shall not be produced, such vessel being provided with a heavily weighted piston, which yields to the dilatation or expansion of the liquid by the heat applied.

3. That fats had been successfully decomposed by steam, and fatty acids produced, the successful production of glycerine at the same time being affirmed by some of the experts sustained by actual trial ; and denied by others whose experiments were improperly made.

4. That in a patent of long prior date, describing the old saponifying process, it was stated that by boiling the solution of fat, lime and water, at a higher temperature than 212° F., under pressure of several atmospheres, (but at lower temperatures than the range specified in the patent at issue,) the proportion of lime could be materially reduced, thereby establishing the fact that a portion of the fatty acids obtained were acidified by the water present, and only a part by the lime.

In view of these known facts, it is a fair presumption

that the patentee, Tilghman, drafted his specification with the knowledge of the facts above stated, and intentionally put in the following limitations in the description of his process :

(*a.*) To the range of heat stated, and such as would alone decompose fats, adding water at those temperatures to hydrate the glyceril and acidify the fats.

(*b.*) To be carried on in a close vessel, entirely full of the mixture of fat and water, so that steam should not be formed ; as he must have known that this could be effected by providing the apparatus with an expansion vessel to yield to the dilatation or expansion of the liquid.

(*c.*) To the use of water in the liquid state, and to the exclusion of steam, to distinguish his process from the previously known process for effecting the decomposition by steam.

(*d.*) To the thorough admixture of the fat and water before charging the vessel, and during the working of the process.

Having thus pointed out the presumptions derived from the state of the art under which the specification must have been drafted, it becomes important to consider the language of the specification in connection with the state of the art, with a view to inquire whether it can reasonably receive so broad a construction as to include the process used by appellant.

a. The high pressure named in the patent is only a consequence of the high temperature required, viz. : from 510° F. to 610° F. The range of heat and not the pressure is the condition required. Water cannot be heated to a higher temperature than 212° F. in an open vessel. Beyond that degree all the heat applied becomes latent in the production of steam. To heat water beyond 212° F. it must be confined, and if the vessel be not filled, as the heat is increased steam will be generated, and its elastic force gradually increased, thereby in-

creasing the pressure on the water until at the temperature of melting lead the pressure becomes equal to nearly two thousand pounds to the square inch. The pressure named in the patent was unavoidable in subjecting fats, in the presence of liquid water, to the high temperatures named in the patent. By superheated steam it can be heated to such temperatures at the pressure of the atmosphere.

With a view to safety, the patentee states that the apparatus to be used should be proved by a pressure of 10,000 pounds to the square inch, and provided with a safety-valve loaded to a pressure of 2,000 pounds to the square inch; and he nowhere suggests or intimates that the process can be worked in apparatus of less strength.

That apparatus of such strength to resist such unusual pressures was deemed necessary is the most conclusive proof that the patentee did not know that the required result could be produced at a lower range of temperature than from 510° to 610° F., depending upon the quality of the fat to be treated. In reference to the temperature, the patentee says: "The melting point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. *But the change of fatty matters into fat acids and glycerine takes place with some materials (such as palm oil) at or below the melting point of bismuth*, yet the heat has been carried considerably above the melting point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased." He then points out how fusible metals can be used to test the range of temperatures varying, tin at 440°, bismuth 510°, lead 610°, and nitrate of potash 660° Fahr.

In the English and Belgian patents, which includes the making of soap, the heat required is given at from 440° to 510° F., and that a higher heat is required for producing free fat acids. (Record, p. 397.)

See also Exhibit B, Record, p. 259.

And then, finally, as to the strength of the apparatus, he says: "I deem it prudent to test the strength of the apparatus to a pressure of ten thousand pounds to the square inch before taking it into use; but I believe that the *working pressure necessary*, in using the heat I have mentioned, will not be found to exceed two thousand pounds to the square inch."

As the patentee, after giving the melting point of lead as the proper temperature to be used in working this process, and then adds, "*but the change of fatty matters into fat acids and glycerine takes place with some materials* (such as palm oil) *at or below the melting point of bismuth*"—which is 510° F.—it cannot be inferred that he knew or believed that such change could be effected at lower temperatures. And after giving the minimum heat, his specification cannot be construed to include any materially lower temperature by reason of an after discovery that the result required can be obtained at a much lower temperature by causing the water to circulate through the fat.

b. It is clear, from the terms of the specification, that the patentee intended to limit the working of this process in a close vessel, to be entirely filled with the emulsion or mixture of fat and water, so that steam should not be generated within the vessel. After stating that the fat to be treated is to be mixed with water, and put in a convenient vessel to be heated, the patentee then says: "*The vessel must be closed, and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.*"

And in the description of the preferred apparatus for working the process (the coil of half-inch pipe), and explaining that the mixture of fat and water are forced in by a pump at one end of the coil, and that the exit valve at the other end is to be loaded so that nothing shall escape except when the pump is in action, the patentee says: "*no steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture.*"

More direct and full instructions could not have been

given to direct the working of this part of the process, so as to insure the complete filling of the vessel with the mixture of fat and water.

The Court below was misled by the testimony of certain chemical experts, who testified that the patentee could not have intended that the vessel should be entirely full of the mixture, because, on the application of heat, the force exerted by the expansion of the liquid would be so great that it would burst the vessel, however strong.

This was an error on the part of the chemists, who in general are not well versed in physics and mechanics. The patentee, at the time of drafting his specification, had full knowledge of the use of vessels so constructed that they could be entirely filled with water and then heated to a high temperature; for in describing the mode of constructing the coil of pipes for the preferred apparatus, he says: "I employ the kinds of joints used for Perkins' hot water apparatus, which are now well known." And it was proved, by one of appellee's witnesses, Joseph Nason, who was for many years familiar with Perkins' hot water apparatus, that such apparatus are entirely filled with water, and are provided with what is known as an expansion vessel, to yield to the dilatation or expansion of the water when heated. The expansion vessel is a cylinder fitted with a piston, loaded to a pressure greater than the pressure due to the heat to be applied to the water, so that when the water expands it simply lifts this loaded piston, keeping the vessel always entirely full. (Record, Q. 4th, 9th to 12th, 14th to 19th, pp. 53 54, 55.)

In view of this evidence and the terms of the specification, it is submitted that the construction of the patent should be limited to the working of the process in a vessel entirely filled with the mixture of fat and water, and kept full during the working of the process.

c. The process described in the patent is further limited to the use of water in the liquid form, and to the exclusion of steam.

The instruction contained in the specification is that steam shall not be present in the vessel during the working of the process. The patentee says: "*The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.*" Pressure how applied? The only way that pressure can be applied to prevent the conversion of the water into steam, is by loading the piston of the expansion vessel beyond the pressure induced by the heat applied. The pressure induced by the application of heat to water is a pressure *produced*, but not a pressure *applied*. And as to the coil of pipes, (the preferred apparatus,) the instructions are direct, that "*no steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture.*" And in that apparatus the load on the exit valve, with the action of the pump in forcing the mixture into, and through the coil of pipe, must be the pressure *applied* to prevent the production of steam.

d. The process described in the patent is limited to the thorough admixture of the fat and water before introducing them into the vessel, and maintaining the thorough admixture during the whole process. The patentee says: "I mix the fatty body to be operated upon with from one-third to one-half its bulk of water."

It is well known that such an intimate admixture, if put in a vessel so that the vessel shall be entirely full, the application of heat to it will not cause the melted fat and water to separate, notwithstanding the two substances are of different specific gravities. But the intention of the patentee, on this subject of the thorough admixture of the fat and water during the working of the process, is put beyond all question in another passage. After describing the working of the process in the coil of pipes, the patentee says: "It is important, for the quickness and perfection of the decomposition, *that the oil and water, during their entire passage through the heating tubes, should remain in the same state of intimate admixture in which they entered.* I, therefore, prefer to place the series of heating tubes in a vertical position, so

that any partial separation which may take place while the liquids pass up one tube may be counteracted as they pass down the next. I believe that it will be found useful to fix at intervals in the heating tubes, diaphragms pierced with numerous small holes, so that the liquids, being forced through these obstructions with great velocity, *may be thoroughly mixed together.*"

That such was the intention of the patentee, appears from the testimony of Jean Baptiste Moinier, to which special reference will be made in another part of the argument, who testifies to the utter failure, in France, of the process; that the patentee and his brother utterly failed to make the process work after six months' trial; and that sometime afterwards the trials were repeated, on the assurance that the patentee had made an improvement in the coil apparatus, which consisted in putting small nails in the tubes; but these trials also failed.

The object of this alleged improvement must have been the better to insure the thorough admixture of the fat and water. (Record, Q. 13, p. 297.)

In view of the obvious intentions of the patentee, it is respectfully submitted, that the patent must be limited to the conditions above stated.

POINT II.

Is the patent at issue a good and valid patent?

The patent at issue is void for the want of a description of means by which the process can be worked practically for the production of fatty acids and solution of glycerine.

The statute requires, as a condition of the validity of letters patent, that the patentee shall give a full, clear and exact description of the invention and of the manner of

making and using the same, so as to enable any one skilled in the art most nearly allied, to make and use the invention. (See Pat. Acts of 1836 and 1870.)

This is not a question of comparative usefulness between the thing patented and other things previously known, as the law does not measure the degree of usefulness if the invention relates to a useful purpose; but it is a question of contract in which the Government secures to the patentee the exclusive right for a term of years, *on condition* that the patentee shall describe some practical mode of making and working his invention. And unless the patentee fulfils that condition of the contract, the Government cannot protect the exclusive right.

By the means described in the patent the process never has, and never can be practically worked.

The patentee patented this alleged invention in England, France and Belgium, as well as in the United States.

The evidence is conclusive to establish the following facts:

(*a.*) That the process described in the patent has never been reduced to practice in the United States by the mode of operation or the means described or suggested in the patent.

(*b.*) That the process was never reduced to practice in England in the business of manufacturing fatty acids and solution of glycerine.

(*c.*) That no evidence has been produced to prove that the process was ever used in Belgium.

(*d.*) That the patentee, after selling his French patent, tried to make the process work, but failed.

(*e.*) That the tests made by the chemical experts, on the part of the patentee, were not made in accordance with the mode of operation described in the patent.

a. The Tilghman process has never been reduced to practice in the United States, by the mode of operation or the means described or suggested in the patent.

No witness was called, on the part of Tilghman, to prove that the process has ever been successfully reduced to practice, in any part of the United States, by the mode of operation or the means described in the patent.

If it had been reduced to practice, the fact could have been easily proved, if by no one else, at least by the patentee and his brother, who acted as his agent in attempts to introduce it. The patentee was examined as a witness on other subjects, but not on this. The attempt was made to prove it by one of his licensees, Charles T. Jones, but on cross-examination this witness proved that what was introduced in his establishment, which was in 1863, and hence four years after the grant of the Wright and Fouché patent of 1859, was an apparatus working by a mode of operation entirely different from the process described in the patent at issue.

Instead of working in a vessel entirely full of the mixture of fat and water, and under a pressure to prevent the presence of steam, it was and is worked in a vessel only partly filled, open at the upper end, and enclosed in an outer vessel, and the heat applied by the introduction of steam from boilers outside.

Instead of being worked at a temperature ranging from 510° to 610° F., and under a pressure of from 1,500 to 2,000 pounds, it is worked at a temperature represented by a pressure of 300 pounds to the square inch.

Instead of the fat and water being maintained in a state of thorough admixture during the entire operation, a pump is kept constantly at work to draw the water from the bottom of the vessel and discharge it on top of the charge of fat, so that in descending, it shall circulate through the fat.

And instead of effecting the decomposition in ten

minutes, it requires six hours—a small proportion of lime being used to aid the chemical action.

(Record, Direct Intrs. 2, 3, 4 to 11, pp. 16 to 20. Cross 23, 24, 25, 36, 37, 41, 50, 51, 52.)

On the part of appellant another patent granted to the said R. A. Tilghman, May 15th, 1860, was put in evidence, which virtually condemns the process of the patent at issue as not practically useful. (Record, pp. 247 to 252.)

Two witnesses, Nathaniel Ropes and Nathaniel Ropes, Jr., were examined on the part of appellant. (Record, pp. 102 and 111.)

It is proved by these witnesses, licensees of Tilghman, that in 1860 the brother of the patentee, and acting as his agent, made numerous experiments at the works of the witnesses, some of which were not successful, and finally successful, and in accordance with which they have since worked as licensees. But the process and apparatus so introduced in 1860, instead of being in accordance with the mode of operation described in the patent at issue, is in accordance with the patent of 1860.

It is worked in a large vessel with a rotating stirring apparatus. The vessel is only partly filled, leaving sufficient room for steam, thereby providing for a partial circulation of steam and water through the fat, and heated by steam from a boiler outside and introduced into the charge; lime is introduced to aid the chemical action. And the heat employed is represented by a pressure of 15) to 160 pounds, instead of nearly 2,000 pounds. And the time of working is twelve hours instead of ten minutes.

And what is a very marked difference, they use, by weight, as much water as fat, one-half the water being applied at first, and after a portion of the glycerine is separated, the water and glycerine are forced out by steam, and the remaining portion of water then introduced to complete the operation.

On the accounting, Charles H. Grant testified, that from the Fall of 1859 to the early part of 1862 he worked under license from Tilghman with an apparatus and process similar to that adopted by Ropes in 1860, but without discharging the water and glycerine after a part of the decomposition was partly effected, and then applying the other portion of water. That the products were defective, and finally he had to abandon it and return to the distillation process with the use of sulphuric acid. (Record, Direct pp. 362 to Ints. 5, 7, 9 to 21 26, 33, 37. Cross, 20 to 34, 61. Re-Direct, 42 to 48.)

ARGUMENT IN FULL (OF SECTION *a*) OF POINT II.

The patentee attempted to prove, by Charles T. Jones, the successful working of his process in the United States.

This witness testified that he first used the well-known process of decomposing fats into fat acids and solution of glycerine, by means of water, thirteen per cent. of lime, and sulphuric acid, in the proportion of two and one half pounds to the pound of lime, heated in open tubs. That he then adopted, in the Fall of 1859, a process in which he used water, six to seven per cent. of lime, and a corresponding reduction of sulphuric acid, in close vessels and heated to a pressure of one hundred and thirty pounds to the square inch. This second one he abandoned. (Record, direct questions 2 and 3, p. 16, cross 23 and 24, pp. 19, 20).

The witness then adopted what he terms the process patented by Tilghman, which enabled him, as he says, to "produce fat acids without the use of lime or sulphuric acid." And that he works this under license from appellee. That he has manufactured about ninety thousand pounds by the action of water alone, at a pressure of three hundred pounds to the square inch; that from six to seven thousand pounds of fat are treated at each charge, and that, by working continuously, he could treat one hundred and fifty thousand pounds per week. That after

the charge has been heated up, the decomposition takes place in about five hours. And that he has been working under plaintiff's process since the 1st of November, 1863; and that he has worked in all, under plaintiff's process, with one-half per cent. of lime, seven hundred and thirty-eight thousand pounds. (Record, direct questions 4 to 11, p. 17.)

It appears, so far, from the testimony of this witness, that he only commenced to manufacture on what he terms plaintiff's process in November, 1863, after the commencement of this suit, and that although he has during that time, treated ninety thousand pounds of fat with hot water alone, he has, in the meatime, treated seven hundred and thirty-eight thousand pounds with water and half per cent. of lime, and with the water heated to a steam pressure of three hundred pounds to the square inch. From the testimony in chief of this witness, the Court would be justified in concluding that the only difference between the process as practiced by him in the treatment of the ninety thousand pounds, with hot water alone, and the process described in plaintiff's patent, is the use of a heat equal to a pressure of three hundred pounds, instead of that named in the patent, namely, melting lead, (or 610° F.,) giving a pressure of nearly 2,000 pounds to the square inch, and applying the heat during five hours instead of only ten minutes. That in all this testimony the witness had reference to plaintiff's patent recited in the bill of complaint is clear.

By the cross-examination, however, it was made to appear:

That no one in his manufactory ever worked according to the process described in appellee's patent. The witness was asked directly: (Cross-question 36.)

"State whether any one in your manufactory ever mixed a fatty body with from a third to a half of its bulk of water, and placed the mixture in any convenient vessel, in which it could be heated to the melting point of lead, 610° F., until the operation was completed, the

product being free fat acids and a solution of glycerine."

To this he answered "No."

And in answer to cross-question 50, he made a like answer as to the coil of tubes.

Now these cross-questions put the patented process to the witness in all its fullness, and the witness was forced to answer that no such process had ever been used in his factory.

In answer to cross-questions 25 to 37, and 41 and 50, 51, 52, the witness was made to describe fully the process he uses, the construction of the apparatus, and the manner in which it is worked. This apparatus was first started in September, 1863, under the superintendence of Tilghman. It consists of two vertical cylinders, one within the other, with an annular space between the two of about an inch and a half. The outer cylinder is thirty-eight feet high and thirty-eight inches internal diameter, and of greater length than the inner one. The fat and the water, in equal quantities, are charged into the inner cylinder, about ten thousand pounds in all, leaving a vacant space of about three feet at the top. The outer cylinder is steam-tight, and the inner cylinder open at the upper end. Steam generated in two separate boilers is introduced through the top of the outer cylinder to the space between the two, and to the inside of the upper one through the open end thereof to heat the inside to a temperature represented by a steam pressure of from two hundred and fifty to three hundred pounds to the square inch. The water is heated in the steam boilers, and forced into the vessel containing the fat. There is a pump connected with this apparatus, which is kept in action pumping the water from the bottom and delivering it on the top of the charge of fat in the inner cylinder, through which it passes to the bottom, thus causing a constant circulation of the water, and necessarily steam with it, through the charge of fat from top to bottom. The pump was an original part of this

apparatus as furnished and started by appellee. When first started, the apparatus was worked under a steam pressure of three hundred pounds to the square inch, and in this way fourteen or fifteen charges were worked, and then, at the suggestion of one of the operatives, half per cent. of lime was added, by which they were enabled to reduce the heat to a pressure of two hundred and fifty pounds to the square inch, thereby saving fuel, labor, and time. And the witness says (Question 31): "I do regard the use of the pump and of some lime essential to the use of the apparatus with the greatest economy."

Thus it is shown, that instead of using the process described in appellee's patent, he uses a process such as described in the patent of Wright and Fouché, of 1859, under which appellant justifies, but with a different apparatus, for whether the water is caused to circulate through the fat by a pump, or by heat, as a process it is the same.

This is the only witness called by appellee to prove that the patented process has been reduced to practice.

On the part of defendant below, two witnesses—Nathaniel Ropes, and Nathaniel Ropes, Jr., were examined. They are experienced in this business, and both testify, in substance, to the same facts. These witnesses carry on business in Cincinnati, the chief place for the business of treating fats. (Record p. p. 102, 111.)

They both testify that they know of no place in which soap and candles are manufactured from free fat acids produced by the use of water alone, at a high temperature and pressure, without the use of alkali. (Question 15, p. 106, and question 6, p. p. 112, 113.)

They both describe the old saponifying process as consisting in the treatment of the fat by water heated in open vessels, lime being used with the water. By this the glycerine was separated and found in the water, leaving what they call lime-soap—that is, free fat acids and lime, which latter was afterwards removed by sulphuric acid, leaving

the free fat acids. And they now operate on a plan introduced to them by Tilghman, in which they use the same agents, but under a change of proportions and degree of heat. They now use water in equal proportions with the fat, a half per cent. of lime, and double that quantity of sulphuric acid, and the whole heated to about one hundred and fifty or one hundred and sixty pounds pressure, in a closed vessel, for twelve hours. Within the tank there is a shaft with radial arms, and during the whole operation this shaft is rotated to keep the fat and water in a state of agitation. And instead of having the tank filled with water and fat, or kept under a sufficient pressure to prevent the water from evaporating, it is never filled, sufficient space being left above for boiling. It is heated by introducing steam into the vessel from separate boilers. This was introduced by Tilghman's brother, (and as his agent,) in 1860, who experimented several months before starting. He tried it without lime at two hundred pounds pressure. He tried it with water, in the proportion of one thousand pounds to two thousand pounds of fat, for twenty hours, and the result was unsatisfactory; and then with two thousand pounds of water to two thousand pounds of fat, applying, during the first part of the operation, one-half of the water—discharging that, and then putting in the other half of the water; and that produced a good result in twelve hours. The addition of the lime enabled them to work at one hundred and fifty to one hundred and sixty pounds pressure, and in less time, and that they have continued ever since. The others, without lime, were mere experiments. (Record pp. 103 to 107.)

In answer to direct interrogatory 9, the witness says: "Under this mode of operation, which I have adopted, the mixer or stirrer is essential to the decomposition of the fat."

Nathaniel Ropes works under license from Tilghman.

Instead of working at the heat of melting lead, giving a pressure of nearly 2,000 pounds, and under a pressure

which will prevent the water from evaporating, and with water alone, these licensees work with lime and sulphuric acid, at a pressure of from one hundred and fifty to one hundred and sixty pounds, in a vessel partly filled with the liquid, to leave room for the circulation, in a vessel, in which steam is not only generated but introduced from a separate boiler, and with a mechanical stirrer to agitate.

The process used and described by these two witnesses, Nathaniel Ropes and son, is very different from the process described in the patent of 1854, at issue.

On May 15th, 1860, six years after the date of the patent at issue, Tilghman obtained another patent, which will be found (Record, pp. 247 to 251).

The patentee in this second patent virtually condemns the process described in the patent of 1854. It will be noted as already pointed out in another part of this argument, that the description of the process in the patent of 1854, demands that there shall be a thorough admixture of the fat and water before and during the entire working of the process. Keeping this fact in view, the special attention of the Court is requested to what Tilghman says in the patent of 1860.

The patentee says :

"My invention relates to the process for obtaining free fat acids and solution of glycerine from fatty substances, by the action of water at high temperatures and pressures, and it is applicable either when water alone is used, or when, in addition to the water, a portion of alkali is used to aid the chemical action. I have observed, in working this process, that though the action of the water in extracting the glycerine from the fat is rapid at first, when the water is fresh, and the fat contains all its glycerine, yet as the decomposition advances, and the fat gradually loses, and the water takes up the glycerine, that the decomposition becomes slower and slower, so that to extract the last portion of glycerine from the fat, with a

moderate quantity of water, requires a considerable time, when the lower range of pressures are used.

Now, if we use a large proportion of water to a given quantity of fat, the decomposition may be made sufficiently complete in a moderate time; but this has the inconvenience of occupying a considerable portion of the vessel or apparatus used, and thereby diminishes the quantity of fat that can be treated therein.

Now, my invention consists in applying the water to the fat in several successive portions. I remove the first portion as soon as it becomes partly saturated with glycerine, and I add successive portions of fresh water to the partly decomposed fat, which fresh water is more active in taking up the last remaining glycerine of the fat, and thereby I render the decomposition more rapid and complete, and can treat a larger quantity of fat in a given apparatus."

Tilghman claims, under the patent:

First. Applying the water in several successive portions, and removing those portions when partly saturated with glycerine.

The license to Nathaniel Ropes, instead of being granted under the patent of 1854, should have been granted under this patent of 1860, as it is evident that the experiment made by B. C. Tilghman, in Ropes' Works, during four months, finally resulted in the adoption of the process described by Ropes.

The process of the patent of 1854 differs from what was used by Ropes in the following respects:

1. The patent of 1854 calls for water in the proportion of from one-third to one-half of the quantity of fat.—Ropes, following the patent of 1860, uses equal quantities of water and fat.

2. The patent of 1854 calls for the thorough admixture of the water and fat before and during the entire working of the process.—Ropes, following the patent of

1860, charges the apparatus with the whole quantity of fat and a portion of the water, and, after working for a time, draws off this water from the vessel with the glycerine so far obtained, and, by steam, forces in another portion of fresh water.

3. The patent of 1854 requires the vessel to be entirely full of the mixture of fat and water, and to be so maintained that the steam shall not be generated.—Ropes, following the patent of 1860, does not fill the vessel, but leaves room for ebullition, *i. e.*, for the conversion of water into steam, and to permit a partial circulation.

4. The patent of 1854 calls for the use of a temperature such as will decompose fats by heat alone—that is, from 510° to 610° F.—Ropes uses a temperature represented by a pressure of from 150 to 160 pounds.

5. The patent of 1854 is clearly based on the idea that highly heated water is to be the sole agent in the decomposition of fats, and the production of fatty acids and glycerine, as distinguished from the old saponification process which used water and lime, with heat at 212° F., *i. e.*, at the pressure of the atmosphere.—Ropes uses a process in which water, with less lime, is used at a higher temperature, equal to a pressure of 150 to 160 pounds.

6. The patent of 1854 does not require the agitation of the contents of the vessel.—Ropes uses a rotating stirrer to agitate the contents in a vessel not full.

A very limited knowledge of the action of heat on liquids of different specific gravities will readily lead to a clear understanding of the reason why the process, as worked at Ropes' establishment, succeeded, and the process of the patent of 1854 could not be reduced to practice.

When heat is applied to a vessel kept entirely full steam cannot be generated; but if the vessel be not full, so soon as it is heated above 212° F., steam is formed at the bottom of the vessel and rises through the liquid to

the open space above; the steam is in turn condensed, and re-descends, so that a continual circulation is produced in the vessel, and the stirring of the liquid facilitates the evolution and circulation of the steam.

As melted fat is specifically lighter than water, if not confined it will float on the water. The vapor of water generated at the bottom being lighter than the water or melted fat, will rise through the fat, and being thereby condensed, will filter down to the bottom, to be in turn again evaporated and sent on another circuit.

In this way the glyceril is gradually separated from the fatty acids, and hydrated, to form glycerine, and then blown out, and a fresh charge of water then introduced,

Such is the mode of operation of the process of the Tilghman patent of 1860, and reduced to practice in Ropes' establishment in 1860.

Where did Tilghman get this idea of causing the water to circulate through the fat, and by its circulation, not only to hydrate the glyceril as it is separated from the fatty acids, but to carry it away from the remaining undecomposed fat, that the fresh water may have free access to the fat to effect the further decomposition? It is not to be found in his patent of 1854, but it is found in the Wright and Fouché patent granted in the United States on the 25th day of January, 1859, and in France in 1857, and under which appellant has and does work, and under which he justifies, as owner of the right by purchase.

In the Tilgham patent of 1860, there are several other modes described besides the one used by Ropes for causing the water to circulate through the fat and carry off the glycerine, but none of them have ever been reduced to practice; and it appears from the testimony of C. T. Jones, on the cross-examination before referred to, that the mode adopted in the apparatus put in use at the works of Nathaniel Ropes, did not, in Tilghman's opinion, work out the idea of causing the water to circulate through the fat with efficiency. So that in 1863 Tilgh-

man introduced the apparatus used by C. T. Jones, in which the water, as before explained, is continually drawn by a pump from the bottom of the vessel and discharged on the top of the fat, steam from boilers outside being constantly supplied to the upper part of the charge.

In the evidence before the Master on accounting Charles H. Grant was examined as a witness, and testified, in substance, to the following effect:

That from the Fall of 1859 to about the beginning of 1862, he worked under license from Tilghman, using a cylindrical digester with semi-spherical ends, with paddles on a shaft extending through the digester from end to end for the purpose of agitating the fat and water while under treatment. That he had two, the first one furnished by plaintiff. The digester in this was heated by fire under it, and steam from a separate boiler was introduced into the digester, at first from a low pressure and afterwards from a high pressure boiler, worked at a temperature represented by a pressure of 160 pounds. A part of the time, used from a half to more than one per cent. of lime. The fat acids produced were inferior to those produced by the old lime saponification process. At the end of about two years he abandoned the use of this process, because it was too expensive, and could not obtain good results, and from that time to the present has used the distillation process, with the use of sulphuric acid. Could not make good candles with Tilghman's process, but he could, by distilling the fat, after it had been treated by the Tilghman process, which was an unprofitable mode of procedure. Says that Tilghman was there frequently, and suggested all the modes of treatment. The supposition was, that with water alone the decomposition would be effected, but found it took double the length of time supposed, and on that account got the second digester; after lime was used do not remember how long it took. As licensees, we paid Tilghman one-fifth of one cent per pound on the neutral fats treated. As we worked the process the profits were not nearly equal to the profits by the sulphuric acid process.

This witness admits that his interests are in favor of Tilghman's success. He says that he has never seen fats decomposed by water without the use of lime, that was satisfactory, except at appellant's factory in New York.

Besides water, heat and pressure, agitation is required. And he also says, that they used, instead of one-third, half as much water as fat; and being referred to N. Ropes' testimony, in which Ropes says that he uses as much water as fat, the witness answered, when we used only half as much water the result was not satisfactory.

The working of the process in either of the digesters, Exhibits "A" and "B," would be substantially different from the working of it in the form of apparatus given in the patent; and even if decomposition could be effected by the apparatus in the patent, it would be valueless. A person of ordinary skill in the branch of business to which the patent relates, could not, from the patent, decompose fats by water, heat and pressure, so as to produce useful and valuable results.

(Record, p. 362, direct interrogatories, 5, 7, 9 to 21, 26, 33, 37. Cross-interrogatories, 20 to 34, 61. Re-direct 42 to 48.)

So far as the proofs show, this was the first attempt on the part of the patentee to apply his process in the actual business of manufacturing fat acids and glycerine in the United States. And it will be shown in another division of this Point that these attempts were after his second failure to work his process in France in 1858.

b. The process was never reduced to practice in England in the business of manufacturing fatty acids and glycerine.

Tilghman became a witness, but instead of testifying to any practical use of his process, described in his patent of 1854, he testified that in London, in June 1854, he exhibited his process in the coiled form of apparatus to G. F. Wilson, Managing Director of Price's Patent Candle Company, in England, and sold to the

said company a license, by which they agreed to pay him, and have ever since paid him, one thousand pounds per annum; that this sum was paid for the use of that process, patented in England, January 9th, 1854; that for the first two or three years they had also the use of two or three other patents, which were considered of minor value, and which expired within two or three years after the agreement was made; and that since the expiration of such other patents the company have continued the payments. (Record, direct questions 1, 2, 3, p. 25.)

On the cross-examination it appeared, that although he was in England from 1854 to 1859, and visited some of the establishments of said company during the years 1854, 1855, 1856, 1857 and 1858, he never saw and could not tell what process they used or at what temperature they worked. (Cross-questions 7 to 16.)

This, of course, utterly fails to prove that this company in England have ever used the process described in that patent; but it leaves an impression that it has, and such impressions sometimes produce like effect, as if actually proved.

The agreement of license referred to was produced and put in evidence. (Record, pages 76–77.) From this it appears that instead of this company agreeing to pay one thousand pounds for the privilege of working under that patent, it is an assignment of the patent, out and out, with the condition to re-assign, if they give two years notice at any time of their intention to discontinue the payments. And instead of the company having, for two or three years, the privilege of using two or three other minor patents, which expired in two or three years, as stated by the witness, it is a like assignment of another patent granted in 1855, and of another invention for which he had then taken a provisional protection, both of which would of necessity extend beyond the term of his patent of 1854, both of these other patents relating to inventions connected with the business in which the company was engaged.

And besides all this, it secures to the company a pre-emption right to all other inventions which may be made by him. This shows how much more reliable documentary evidence is than man's weak and erring memory. This paper is not found in the record, but will be found at the end of this brief, marked Appendix (A).

With a view to strengthen the impression sought to be induced by plaintiff's examination in chief, they put in evidence a paper read before the British Association, in September, 1855, by G. F. Wilson, the person to whom appellee says (cross-question 9) he exhibited his process in 1854.

This paper, instead of tending to show that the said company were at that time (1855) using Tilghman's patented process, the author distinctly says: "In our new process the only chemical agents employed for decomposing the neutral fat and separating its glycerine are *steam and heat;* and the only agents used in purifying the glycerine thus obtained are *heat and steam.*"

And in a paper published in the Journal of the Society of Arts, January 25, 1856, also put in evidence on the part of appellee. Wilson says of Tilghman's process, that "it has yet to be proved how far it can compete successfully with distillation. We have made an arrangement with Mr. Tilghman which will give us the means of testing its commercial merits;" and then he proceeds to state, that on witnessing Tilghman's trial with a small tube apparatus, (described as the preferred mode in Tilghman's patent), "it struck me, that steam passed into the fat at a high temperature should effect, by a gentle process, what Tilghman aimed at effecting by a violent process, viz: the resolving of the neutral fat into glycerine and fat acids. We proved that this was so, and that the glycerine distilled over in company with the fat acids, but no longer combined with them. In July, 1854, we took out a patent for this process, by which many hundred tons of palm oil and other fats have now been worked, and which has given to the arts and

medicine a body never before known, either in France or here, even in the chemist's laboratory;—glycerine which had passed over in the form of vapor, without a trace of decomposition." (Record, pp. 90, 96.)

It thus appears, not only that appellee failed to prove that his process had ever been reduced to practice in England, but that, instead, steam alone was used and patented in England in July, 1854, by Wilson and Payne, but which had been previously patented in France in 1841 and 1842 by Dubrunfaut (Defendant's Exhibit 4, Record p. 233), and published by Scharling in 1850 (Defendant's Exhibit 10, Record p. 237). If the steam process, thus proved to be the only process used by the Price Company, is appellee's process, and it would seem to be so in his judgment, as these papers published by Wilson were put in evidence on his part, then it follows that the Tilghman patent is void for the want of invention.

(*c.*) No evidence has been produced to prove that the process was ever reduced to practice in Belgium. The grant of a patent in that country is not evidence that the process can be worked practically.

(*d.*) The patentee, after selling his French patent, tried to make this process work, and failed.

No evidence was produced, on the part of appellee, tending to prove that the process was reduced to practice in France. But, on the part of appellant, it was proved before the Master that appellee entered into a contract of sale of his French patent to a company in France, on condition that, by his process, he could successfully decompose fats, and produce therefrom fatty acids and solution of glycerine. The experiments were to be, and were made at the expense of the company purchaser. The experiments were made during six months by the patentee and his brother, and cost the company forty thousand francs, and ended in total failure.

The contract of sale was annulled on admission of failure.

In 1858, on representations by his agent that the patentee had made improvements, which had rendered the process successful in the United States, another contract of sale was entered into by the same company, jointly with another company; trials were made, and, like the first series, resulted in total failure to make the process work. The alleged improvement consisted in putting small nails in the tubes to insure the thorough admixture of the fat and water, while being subjected to heat in passing through tubes.

See testimony of J. B. Moinier, taken in France by commission.

The commission will be found, Record, p. 283; direct interrogatories, pp. 284, 285, 286; cross-interrogatories, pp. 286 to 289; answers to direct interrogatories, pp. 293 to 298; answers to cross-interrogatories, 298 to 301.

ARGUMENT OF THE FOREGOING AS TO THE FAILURE OF THE TILGHMAN PROCESS IN FRANCE.

From the testimony of Moinier, it appears that he was the manager of "La Societe generale de Stearinerie, of Moinier & Co., near Paris," the largest establishment for that purpose in France. That he made the acquaintance of R. A. and B. Tilghman, in London, in June or July, 1854, through Mr. Moreau, a patent agent in France, in whom the house of Moinier & Co. had great confidence, and who was acting as agent for the sale to them of Tilghman's French patent of 1854. That a contract was entered into between Moinier & Co. and Tilghman, some time in the latter part of 1854, or early in 1855, by which contract the said firm would become the owners of the French patent, if the experiments to be made in the company's works gave the results promised (Direct Inters. 1, 2, 3, 4).

The experiments were made, for the first ten or fifteen days, by Tilghman, and after he left, by his brother. The experiments lasted six months. That besides the coiled apparatus, which Tilghman brought from London

three others were constructed under the directions of Tilghman and his brother. They all failed to produce fatty acids and glycerine. The experiments cost the company forty thousand francs, including twelve to fifteen thousand francs paid to Tilghman's brother. After the failure, the agreement was annulled by mutual consent, because the process failed to produce fatty acids and glycerine. The witness says, we made the experiments with the intention of using the process in our factory if it gave promised results (Direct Inters. 5, 6, 7, 9, 10, 11).

Who for a moment can doubt this statement? The failure must have been a source of regret to the witness and his associates, because, as manufacturers, they must have known that the process would be much cheaper, if successful, than the other processes, and, as by contract, they were to own the patent, it would have given the company the monopoly of the business.

The witness states, distinctly, that it is impossible to produce fatty acids and glycerine by what is described in the patent (Direct Inter. 11).

After the experiments the furnaces were destroyed, and the apparatus stowed away in the store-house. He does not know that any other person in France has manufactured according to the process described in the patent (Direct Inter. 13).

But this is not all. The witness testifies, that afterwards, in 1858, this firm was induced by Mr. Moreau, Tilghman's agent, to enter jointly, with the firm of Leroy & Durand, into another contract with Tilghman for another trial of this process, improved, on the representation that Tilghman was sure to succeed, *as he had already obtained admirable results in the United States.* Under this new contract experiments were made during three months under the direction of Tilghman's brother, and, like the former, failed to produce either fat acids or glycerine. The new improvement which induced the promise of such important results, consisted in putting small nails into the coiled tube to retard the emulsion in its passage through the coil (Direct Inters. 14 to 17).

The cross-interrogatories, instead of shaking the testimony of this witness, brought it out with more force.

Taking advantage of the high respect paid to judicial decisions by Frenchmen of standing, he was asked (Cross-Int. 2) if he had been informed that in this suit it had been decided, as appeared by the opinion of the Court appended to the question. To which he answered, "Yes, I learned, but not without surprise, that Mr. R. A. Tilghman pretended to be the inventor of the chemical discovery, that by the action of water, at a high temperature and under a strong pressure, fatty and oily substances could be decomposed, and that the fat acids and glycerine could be separated, and that *this process could be successfully prosecuted by the means indicated in the patent.*"

His surprise, no doubt, would have been greatly heightened, if this experienced witness had been informed that the decision of the learned Court was based on the testimony, under oath, of several men calling themselves professors of chemistry. Then, in the 3d cross-interrogatory, the order of accounting, in the decree of that Court, was put to the witness, and he was asked whether the Court had so ordered. To this the witness answered, that he did not know of the order of the Court, or that the defendant had summoned him to testify as to the amount of gains and profits he had received from infringing plaintiff's patent, and then adds: "*I do not know what profits could be realized by a method which damages fatty bodies, without decomposing them.*"

To the fourth cross-interrogatory he says, that he knows nothing of the operations in defendant's factory; that he has never been in the United States, and that he does not know the defendant.

Being asked (5th cross-interrogatory) his opinion, as a chemist and manufacturer, as to the decomposition of fats in a close vessel by water and heat, he made the practical and significant reply, that, in his opinion, they could not, "to the point of producing fat acids and gly-

cerine. That is so true, that Mr. Tilghman was not able to obtain that result at Paris in my presence."

In answer to the sixth cross-interrogatory, he admitted, that before the first contract, he had seen in plaintiff's room, in London, the small coil apparatus and small specimens of fat acids and glycerine; he does not, however, admit that they were made in the coil apparatus, but says he was *informed* that they were so produced. From this it is evident, that he did not see the small coil apparatus at work in London, but was induced to make the contract by the confidence reposed in Moreau, Tilghman's agent, and by the assurance that the specimens exhibited had been produced by the coiled apparatus.

It appears that the last agreement of contract between Tilghman and Moinier & Co. and the firm of Leroy & Durand, under which his process was tested by a second series of experiments, was annulled, by reason of Mr. Tilghman's having failed to make his process work.

Now these tests and experiments were not made with a view to determine whether, by the Tilghman process, fatty bodies could be decomposed at a less cost than by the other processes then in general use; but they were made to determine whether, by Tilghman's patented process, fatty bodies could be practically decomposed to obtain fatty acids and glycerine by means of water at a high temperature and pressure. (Answer to 5th cross-inter.)

What can be more conclusive to establish the utter worthlessness of what is described in complainant's patent? He failed to introduce it in England, and he also failed in France, after many trials at two different periods of six months, in 1854 or 1855, and again for several months in 1858, experiments conducted by him and by his brother, at the expense of Moinier & Co., and afterwards at the expense of that firm and Leroy & Durand, and under contracts which, if successful, would have given him a large income. Tilghman had every advantage, and yet, under the most stimulating circum-

stances, utterly failed to produce successful results; the last trials and failures having occurred in 1858, four years after the grant of the patent. These last trials in France were made in 1858, and not a witness has been produced to prove that the process, as patented, was at any time reduced to practice in the United States, although Moinier & Co. were induced to go into the second series of experiments, by assurances, in 1858, that Tilghman had obtained admirable results in the United States by introducing small nails into the coil of pipe.

After this testimony was put in on the part of appellant, the patentee and his brother were both examined, but did not attempt to deny or contradict any of the statements of Moinier.

The patentee testified to having received two letters, one marked complainant's Exhibit 1, said to be from L. de Fontaine Moreau, dated London, July 18th, 1857, and enclosing one dated La Villette, near Paris, July 17, 1857, signed "Moinier," and marked Exhibit 2. (Record, pp. 270, 271, 272.)

The letter, Exhibit 2, is not proved to have been written or signed by Jean Baptiste Moinier, the witness whose testimony neither of the Tilghmans attempted to contradict, and if the said letter is competent evidence, it is in answer to one from Moreau, which is not put in evidence. This letter refers to an alleged use of the Tilghman process by one De Milly. In answer to cross-interrogatories 16 and 17, Moinier testified that he had no other than hearsay knowledge of the process used by De Milly; that he had been informed, that De Milly used water in a closed vessel, with lime and some alkali.

It would be difficult to conceive in what manner this [illegible], even if proved, could contradict the witness Moinier. But by reference to complainant's Exhibit N (Record, p. 269), it will be seen, that De Milly obtained a patent dated November 19th, 1856, No. 2,740. For some reason best known to the other side, instead of putting in the whole description of the De Milly patent, ex-

tracts only were put in evidence, but enough to satisfy reason, that De Milly's process was very different from Tilghman's.

The first part is for the acidification of fats by lime, or other alkalies, or metallic oxides in less quantities, under a high pressure.

The second part is for the use of copper-lined vessels.

The third part for the use of steam for effecting a stirring or combination between the fatty bodies and the lime.

The fourth part is for the production of glycerine in an apparatus acting under a high pressure.

The sixth part is for heating the vessel internally, and the elevation of the mixture by a jet of steam.

This, evidently, is the patent under which De Milly was operating in 1857, and it is possible that, at that time, Moinier may have been under the impression that De Milly had succeeded, by some modification of the Tilghman process, for, in the year after, 1858, he joined in the agreement to let Tilghman make the second series of experiments, which failed, as well as the first series.

As to the other letters, Exhibits 3 and 4 (Record, pp. 271 to 275), Exhibit 3 is from Moreau, dated Paris, March 5th, 1855, inclosing Exhibit 4, dated La Villette, March 4, 1855, signed Moinier, accepting the terms of the exclusive license, if the Tilghman process, on trial, shall prove successful.

Moinier, in his testimony, said, from recollection, that the contract was made in the latter part of 1854, or early part of 1855, and this letter, dated March 4th, 1855, even if proved, would not contradict Moinier as to the time of the trials; in fact, so far as it goes, it confirms his testimony.

The testimony of Moinier, as to the total failure of the

two series of trials in 1855 and 1858, in France, stands unimpeached.

(*e.*) The tests made by the chemical experts on the part of appellee were not made in accordance with the mode of operation described in the patent.

As the means described in the patent had never been reduced to practice in the business of manufacturing fatty acids and glycerine, and the attempts to prove it had resulted in proof that it had failed, and that what did succeed was a different process, it became necessary to furnish some proof that it could be done.

The usual way of making such proof is by persons having practical knowledge of the business to which the patented invention relates; but appellee, in this case, pursued a different course; he attempted to do it by the testimony of a number of brother chemists.

These witnesses testified to experiments made in Philadelphia with what they say were both kinds of apparatus described in the patent: the coiled apparatus, which is the one referred to in the patent, and a closed vessel or digester. And the most that can be made out of that evidence is, that they succeeded in producing some small specimens of fatty acids and glycerine—enough to swear by—but all the specimens were injured by the presence of acroleine.

The witnesses called on all the chemical questions, and who testified on the subject on the part of appellee, are: James C. Booth, Robert Bridges, Robert Rogers, and F. A. Genth, all of them but the last, professors, and none of them ever having been engaged practically in the business to which this invention relates. They are theorists, and as is usual with this class of men, prone to conduct experiments with a view to confirm preconceived notions, and they exhibit more skill in the art of conducting the experiments, so that they shall prove such preconceived notions, rather than the truth.

The tests were not made on the part of appellee in accordance with the description in the patent.

They consisted of three kinds, the first and third to represent the first mode described in the patent, and the second to represent the preferred mode, the coil of tubes.

The first was made by putting the fat alone in a small tube made of gas pipe, closed at bottom, and open at the upper end, only half full of fat. This was put in a larger pipe, half full of water, and entirely closed; steam generated in this outer vessel had free access to the fat in the inner vessel. The apparatus was heated to the melting point of lead for some time, and the whole then shaken to mix the water and fat. Traces of acroline were found even in this test.

See testimony of Prof. Booth. (Record, Direct Int. 9. Cross-Ints. 60, 64, 66, 67, pp. 41, 42). F. G. Genth, (Record, Direct Ints. 5, p. 71).

It will be noted that in this test, there was no thorough admixture of the fat and water, before and during the first half of the process. The vessel was never full of the emulsion of fat and water, and instead of being so full and under such pressure as to prevent the presence of steam, steam was not only present, but, during the first half of the process, steam, and not water, acted on the fat. In this test all the conditions specified in the patent were omitted except the temperature.

The third test was also made by Prof. Booth in the presence of Dr. Genth.

A few ounces of fat and water were separately charged in a horizontal tube heated by gas burners under the bottom. The fat and water did not fill the vessel, leaving about one-third of the capacity for steam room. The fat floated on the water, and steam generated from the water circulated through the fat, was condensed, and the water returned to the bottom, filtering through the fat.

See testimony of Prof. Booth, (Record, p. 65, Direct Ints. 1, 2, 3; Cross, 20, 28, 29, 30, 31, 34, 42, 44 to 49).

The success of this test was due to circulation, and to

a total disregard of the instructions in the patent, except as to temperature.

The second test was made with a modification of the coil of tubes, the preferred mode described in the patent, and so arranged as to cause the mixture of fat and water to travel upwards, and to be discharged furthest from the fire, instead of traveling several times up and down and passing several and the last time nearest the fire. And even with this ingenious deviation from the description in the patent, with the view to avoid the decomposition of the glycerine into acroline, the decomposition of the fat was imperfect, and the witnesses had to admit that some acroline was produced, and instead of ten minutes the mixture was twenty-six or twenty-seven minutes in passing through the coil.

See testimony of Prof. Booth (Record, Direct Ints. 9, 14, 44; Cross 79, p. 43). Prof. Bridges (Record, p. 55, Direct Int. 7 to 12; Cross, 19, 20, 21).

The evidence on the part of appellant as to tests made of the process by the means described in the patent, is conclusive to prove that the tests made on the part of appellee are not reliable, and confirm the testimony of J. B. Moinier, as to the failure of Tilghman and his brother to work the process in France.

As all the experiments testified to on the part of appellee were made *ex parte*, a request was made on the part of appellant for the privilege of re-testing the working of the coil apparatus in his presence, but this request was not granted. (Record, bottom of p. 64, and p. 65.)

Appellant then, at considerable cost, had a coil apparatus made in exact accordance with the description in the patent, and offered with it to repeat the trials in the presence of appellee, and if found not to conform to the patent, to make such alterations as might be required. (Record, middle of p. 74, pp. 97, 98.)

The coiled apparatus, so made in accordance with the description in the patent, was repeatedly tried by, and in the presence of experienced manufacturers of fatty acids

and glycerine, all of whom testify that the process is utterly worthless, producing acroeline in every instance, which tainted both the fatty acids and the glycerine—some of them testifying that the product was worth less than the fat before being treated.

See the testimony of Joseph T. Verdin (Record, p. 196, Direct Ints. 1 to 15).

> At the melting point of bismuth, and less than melting point of lead, the fat was not entirely decomposed, and so much acroleine was produced that it affected the eyes. If the heat had been increased or the time prolonged beyond ten minutes, the decomposition would have been more complete, but more acroleine would have been produced. The fat acids and glycerine were seriously injured.

Florence Verdin to the same effect (Record, p. 225, ints. 1 to 10).

C. T. Jones (Record, p. 324, ints. 6 and 7.)

> Product was a mixture of neutral fat, fat acids and acroleine. The fat acids strongly impregnated with acroleine, and apparently unfit for candles.

George Shillito (Record, p. 331, ints. 3 to 17).

> The fat acids were imperfect and the glycerine destroyed. He says that the process worked in that apparatus is of no earthly use to anybody. It cannot be practically used for the manufacture of fatty acids.

Michael Werk to the same effect (Record, p. 335, ints. 1 to 5).

Florence Verdin to the same effect (Record, p. 340, ints. 4 to 16).

R. G. Mitchell to the same effect (Record, p. 351, ints. 19 to 28).

Charles H. Grant (Record, p. 362, ints. 26).

> The trials with this coil of tube apparatus were first made in New York in 1864, and again in Cincinnati in 1867, and often repeated.

The process, as first described in the patent, was also tested on the part of appellant, and proved to be worthless. In every instance the decomposition was

imperfect, and the fatty acids and glycerine tainted by the presence of acroline.

See testimony of
Prof. Van Der Weyde (Record, p. 149, ints. 5 to 16).
Prof. Doremus (Record, p. 173, ints. 3 to 17).
Jos. T. Verdin (Record, p. 114, ints. 106 to 118).
Florence Verdin (Record, 142, int. 14 to 33).

ARGUMENT ON THE EVIDENCE RELATING TO THE EXPERIMENTS WITH THE MEANS DESCRIBED IN THE PATENT FOR WORKING THE PROCESS.

At first, two sets of experiments were testified to.

Professor Booth was the first examined, and was the most elaborate in his testimony. Two kinds of experiments were made by him, namely: the first, in a double digester not named in the patent; and the second, a coiled apparatus modified from that specifically described in the patent. They are detailed by him, in answer to direct question. (Record, Ints. 9, 10, 11, pp. 28–29.)

In the first place neither of these experiments was conducted in conformity with the description in the patent.

As to the first: The patent directs that the *fatty body to be treated shall be mixed with water* in the proportions named, *and then put in any convenient vessel in which it can be heated to the melting point of lead, until the operation is completed. The vessel must be closed, and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of water into steam.*

And it will be noticed, that there is not the most remote allusion to any agitation of the mixture within the vessel, or of the vessel itself, during any part of the process after the mixture has been put into the vessel.

The first experiment was made by Booth in the presence of Dr. Genth.

Did these searchers after truth follow these instructions? Not at all. They were experimenting on what they found in the patent many years after 1854, as read by them by the lights of knowledge acquired since the grant of the patent.

Now observe what they did. The witness describes it on pp. 27 and 28. The apparatus, instead of one vessel, consisted of two pipes, one within the other. The outer pipe, two inches in diameter, and of considerable thickness, contained the water (half full), and within this water was placed the inner, smaller pipe (small gas-pipe), containing pressed lard (not full). It was heated in an inclined position, as he says, to prevent the fat from mixing with the water, until it attained the temperature of melted lead, when the whole was shaken for five minutes, so as to mix the fat and water. The products were produced, marked Exhibits W 1 and W 2.

We will now call attention to the deviations from the patent.

Instead of thoroughly mixing the melted fat and water to make an emulsion before charging into the vessel, and maintaining this admixture during the process of heating, as required by the patent, in this trial, the fat and the water, as a liquid, were kept separate until after both had been heated to the temperature of melting lead.

Instead of having the vessel full of the emulsion, "to prevent the conversion of the water into steam," as stated in the patent, the inner tube was only about half full of the fat alone, and the outer vessel only about half full of water, and as the upper end of the inner vessel was open and within the outer one, steam was generated in the outer vessel, which steam passed over into the upper part of the inner vessel, and there acted on the fat, so that until the whole reached the temperature of melting lead, the fat was being decomposed by the heat, and the glycerine hydrated by the steam, and then, after all this, the apparatus was well shaken to affect the admixture of the fat and water.

The steam that passed over into the inner vessel was condensed by the fat contained therein, and, so condensed, filtered down through the fat.

What induced these two experts, in company with appellee's brother and agent, to deviate so much from the mode of operation described in the patent?

Tilghman's brother had learned by experience that, as described in the patent, the process could not be worked, and having become acquainted with the necessity of causing the water to circulate through the fat, from the Wright and Fouché patent, and from the experiments at Grant & Co.'s works in 1859 and 1860, and at Jones' in 1863, he must have led those learned chemists to make the experiment, as detailed by Prof. Booth.

It will be noted that, in the Wright & Fouché patent, the fat is put in one vessel, which is not filled, and the water in another vessel, and the two are so connected, that steam is generated in the water vessel, passes into the upper end of the fat vessel, and there acts on the fat, and this mode of operation was adopted by Tilghman in 1863, at C. T. Jones'.

On cross-examination this witness gave the dimensions of this apparatus and the manner in which it was charged. Instead of trying, on a practical scale, the outer pipe was but two inches external diameter, and of considerable thickness—length not given—and the inner one was made of small gas-pipe, closed at one end. (Cross-question 60, p. 41.)

The whole fat so treated did not amount to more than a few ounces. (Cross-question 64, p. 42.)

And instead of filling the vessel with the mixture, so as to prevent the conversion of the water into steam, the inner tube was only half filled with tallow, and the space between the inner and the outer tube about half filled with water, no means being provided to make pressure on the liquids to prevent evaporation and mixture by ebullition. (Cross-questions 66, 67, p. 42.)

Another test was made by Prof. Booth in the presence of Dr. Genth.

Several ounces of pressed lard and half as much water were put in a tube and subjected to the heat of melting lead for forty minutes, producing fatty acids and glycerine, and very little acroeline if any. (Record, Direct Ints. 1, 2, 3, p. 65.)

No intimation was given in the examination-in-chief as to whether there were any deviations from the instructions given in the patent; but on the cross-examination it was made to appear, that the fat and water were not mixed before being put into the vessel, but were put in separately, and the vessel, instead of being full to prevent the production of steam, it was only partly filled, and the space above, filled with steam during the operation, and on the application of heat, the fat and water were separated into two layers. (Record, cross 20, 28, 29, 30. 31, 34, 42, 44 to 49.)

The success of this test was due to the fact that the fat floated on the water; the water was evaporated and the steam passed up through the fat, so that the decomposition was effected by the circulation, and by a mode of operation entirely different from what is described in the patent.

Then, as to the experiment with the coiled apparatus. This was made by Prof. Booth, in the presence of Profs. Bridges and Rogers:

The coiled apparatus, described and represented in plaintiff's patent, consists of a pipe, which is so coiled as to have the greater part of its length vertical, and bent at top and bottom to connect the vertical parts. The emulsion of mixed fat and water is introduced near the bottom by a pump, and is caused thereby to travel up and down, according to the drawings, twenty-four times —that is, twenty-four times up and twenty-four times down, and as many times across at the top and at the bottom. This coil is placed over a furnace, so that the

lower part of the several coils, which connect the vertical parts of the pipe, are just over the fire in the furnace, and must of necessity become more highly heated than the other parts of the coil, and the exit or discharge pipe runs out directly from the bottom of the coil, and hence in close proximity to the fire in the furnace. By this arrangement the mixture, in its course of travel, would pass twenty-four times directly over the fire, that is, through those portions of the coil which are immediately over the fire.

Instead of trying the experiment with such an apparatus, these witnesses took a coil in the form of a distiller's worm, rising in successive coils from the bottom to the top, five feet in height, and placed the discharge at the top of the coil, instead of the bottom. The mixed fat and water was forced in at the bottom near the fire, and gradually traveled up away from the fire to the top, where it was discharged. At what part of the height of this coil the temperature was ascertained does not appear. With this apparatus they treated about *two gallons of fat with one gallon of water, which occupied about one hour.*

The difference in the mode of construction tended to prevent the destruction of the glycerine and the production of acroleine, because the high temperature was applied to the material when first introduced and before it became highly heated, and as it traveled upward in the coil, it gradually receded from the intense heat up to the place of delivery, so that instead of being exposed, during the entire operation, to the temperature of melting lead, it was only so exposed at the beginning and before decomposition took place.

In both these experiments acroleine, however, was produced. This substance is excessively acrid, produced from glycerine when exposed to a high temperature, and this of itself would prevent the practical use of the process.

In answer to Int. 14, Booth says no acroleine was

produced, and in answer to Int. 44 he admits some was produced.

Bridges and Rogers also admit the presence of it. (Record, pp. 57–61.)

The decomposition was not complete, a small portion of the undecomposed fat having been found. (Direct question 9, p. 28.)

The coiled apparatus is not suitable for manufacturing, although the witness Booth says it is. It was operated for about one hour, and it would produce at the rate of from four hundred to four hundred and fifty pounds in twenty-four hours, whilst the apparatus worked by Jones and by Ropes, licensees of plaintiff, but which worked a different process, worked from six to seven thousand pounds in five hours. (Question 10, p. 28.)

Prof. Booth rests his judgment of the economical working of the coiled apparatus, on the assumption that it costs nothing to work it, which is simply absurd, as there is the cost of the apparatus, the fuel consumed in keeping up such high temperatures, and the labor of constant pumping and watching the working of the apparatus.

But it may be said that the coil can be enlarged. Not so in a practical point of view. The high pressure, fifteen hundred to two thousand pounds to the square inch, is such that nothing short of madness would induce any one to risk the working of it in materially larger tubes.

Prof. Booth tested this in the laboratory as a question of chemical science, and he was not competent to test it as a practical manufacturer.

Prof. Bridges (Record, 55 to 59) testified to same experiments witnessed on the ninth of March, 1864, with Tilghman's coiled apparatus. Prof. Booth was present, but they were not those to which he testified. Prof. Bridges produced specimens of the fat used, and

of the products, marked severally Exhibits L^1, L^2, L^3, L^4, L^5. The fat acids produced after much treatment of after processes, are not yet pure.

The glycerine, L^5, is not quite pure—admits it contains acroline (direct questions 7, 11).

On cross-examination some important facts connected with the structure and operation of the coiled apparatus became known, which did not appear in the testimony of Prof. Booth.

The coiled apparatus was five feet high. It was heated by a stove below, and instead of the coil being embedded in cast iron to equalize the heat, as described in the patent, there was a clay cylinder within the coil, and extended up from the stove about one-third the height of the coil. After the mixture began to issue from the exit tube, "the flow was continuous, without any variation, except, perhaps, in rapidity," and the exit valve continued open all the while. (Cross-questions 19 to 30, p. 58.) This was an unfortunate admission, and it became necessary, on the re-direct, to try to change it, but the attempt did not succeed, for, in answer to question 33, he says: "I observed, when the pump was stopped, that the flow diminished in rapidity."

He could not tell the amount of pressure on the exit valve, but he says: "It was sufficient to produce such an effect on the valve as not to allow the escape of the water or mixed liquids until they had attained the temperature of melting lead," (cross-question 27, p. 58). This proves conclusively that the experiment was not conducted in accordance with the description in the patent. In the first place, during the progress of the process, the mixture was caused to travel gradually away from the intense heat of melting lead. Why was this done? The answer will be found in the witness's reply to the 14th cross-question, where he incidentally states that the temperature at which acroleine is formed is between 550 and 600 degrees Fahrenheit—confirmed by Prof. Rogers, cross-question 23, p. 63. Appellant's witnesses say as low as 450 degrees Fahrenheit.

Now, as the temperature of melting lead is 610 degrees, as given in the patent, it must follow that if they had made such a coiled apparatus as is described and represented in the patent, in which the mixture has to pass twenty-four times through those portions of the coil nearest the fire of the furnace, and finally passed to the discharging coil from a portion of the coil nearest the fire, and at the time the decomposition is nearest complete, the fat being thus exposed to a temperature above that at which acroleine is formed, such acrid matter would have been abundantly produced, and the process would have been proved to be utterly worthless. But as acroleine is produced from glycerine, and this substance must, therefore, be first separated from the fat acids before it can be changed into acroleine, these learned professors were induced to try the experiment in an apparatus so constructed that before the glycerine could be separated from the fat acids, the material should reach such an elevation in the coil, and such a distance from the furnace, as to be under the action of a temperature too low to produce acroleine; and even with all this precaution some was produced. And produced because they made a mistake, as I will show presently, in the degree of heat at which acroleine is produced. It is, in fact, produced below the melting point of bismuth. But this is not all. Instead of following the clear and distinct instructions of the patent as to the loading of the exit valve, they pursued a very different course. The instructions in the patent are: "The exit valve 2 is so loaded that when the heating tubes (*d*) are at the desired working temperature (melting lead), and the pump (*e*) is not in action, it will not be opened by the internal pressure produced by the application of heat to the mixture; and therefore *when the pump* (*e*) *is not in action, nothing can escape from the valve* (*i*), if the temperature be not too high." And then, after stating that when the pump forces in mixture an equal quantity will escape through the valve, the patent says: "No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture" (p. 5).

Instead of this, we have the admission of Professor Bridges, that the material flowed from the exit pipe, when the pump was not in action, and why? Because, instead of loading the valve considerably above the pressure due to the temperature of melting lead, so that vapor should not be produced by such temperature, they loaded it, as the witness says, "sufficient to produce such an effect on the valve as not to allow the escape of the water or mixed liquids until they had reached the temperature of melting lead." When it reached that temperature, the valve was opened by the generation of steam, to force out a portion of the liquid to make room for itself to expand in, and so long as the temperature was at that degree, or higher, the mixture would continue to be forced out by the elastic force of steam within the coil while the pump was not in action.

Thus it is clear that the experiments were made with a steam and water process, conducted at a temperature, in fact, below that given in the patent as the only known means, instead of a hot water process under the restrictions specified in the patent, as the full extent of the knowledge possessed by the plaintiff at the time of applying for his patent.

Professor R. E. Rogers does not change the condition of the evidence on this point. He witnessed the experiment with the coiled apparatus to which Professor Bridges testified, and he admits the production of some acroleine. (Record, direct questions 6 and 7, p. 60).

Prof. Booth was recalled, and testified to another experiment made by him on the 23d of March, 1864, after his previous testimony.

The confessions drawn out of Booth by the cross-examination, in his first deposition, as to the experiment with an apparatus consisting of an outer closed tube to contain water, and an inner tube, with the upper end open, to contain the fat, was evidently deemed by appellee as failing to prove his process. It became necessary to

prove something more nearly like the process described in the Tilghman patent. He was put to the task.

The description which he gives of this test, in his examination-in-chief, would lead to the belief that it was honestly made in accordance with that part of the patent which says the process may be worked "in any convenient vessel in which it can be heated to the melting point of lead" (Direct questions 1 and 2, p. 65, Record). But, on cross-examination, he was required to explain the details, and then it appeared that the apparatus was a tube of wrought iron, 19 inches long, exterior diameter 2 inches, lined with copper, and internal diameter $1\frac{1}{8}$ inch. It was the outer tube of the apparatus used in the experiment made previously. The fat and oil were not mixed before being charged. The vessel was horizontal, was only two-thirds or three-quarters full, was heated by gas burners, under the lower part, and the space above the fat and water filled with steam.

(Record, p. 68, cross-questions 20, 21, 28 to 35; 42 to the end.)

With such an apparatus, fat being lighter than water, and the vessel not entirely full, the fat floated on the water, and as the heat was applied to the bottom of the vessel, steam was there generated, and being much lighter than the melted fat, passed up to the steam space above, and, by degrees, would be condensed, and pass down again through the fat to the bottom, to be again evaporated. Thus, a constant current of steam was caused to pass up through the fat, and, after condensation, permitted to trickle down through the fat.

The process, so worked, is so entirely different from the process described in the patent, that the statement made by the witness, in his examination in chief, indicates that he either lacks judgment, or is too much of a partisan.

The next witness to prove the usefulness of the process was Dr. F. A. Genth. (Record, p. 70 to 74.)

This witness testifies to the making, in 1860, the same experiments as that testified to by Professor Booth, with two small tubes, one within the other, the outer one containing water, and the inner one the fat, heating them without admixture, and after reaching the temperature of melting lead, shaking them so as to effect the mixture of the water and fat at that high temperature, leaving the mixture exposed for five minutes to the said high temperature, and then suddenly cooling.

It has already been shown, in reviewing the testimony of Professor Booth, that this is no test of the process described in plaintiff's patent, and it is unnecessary to repeat what was then said. But it may be said that this experiment was well contrived to prevent the formation of acroleine. They were obviously so much afraid of the production of acroleine, that they did not continue the process long enough to decompose all the fat. It is true that Dr. Genth does not say that a portion of the fat was undecomposed, but Professor Booth, who had also avoided stating that fact in his testimony-in chief, was forced to admit it on cross-examination. (Record, cross-interrogatory 63, p. 40.)

We pass now to the evidence put in on the part of appellant, to show that by the process and means described in the patent, it is impossible, practically, to decompose fats and produce therefrom fatty acids and solution of glycerine.

On the part of appellant it was proved by Joseph T. Verdin that he tried the plan first described in plaintiff's patent several times as therein described. The result was invariably the production of acroleine, with the fat acid and glycerine, and when he exposed the matter to the heat for only five minutes, the proportion of acroleine was less, but the fat was not all decomposed. The witness testifies also that the production of acroleine reduces the value of the products from one and a half to two cents per pound of the original fat. (Record, ints. 107 to 118, pp. 123, 124.)

The statements of this witness are fully sustained by the testimony of—

First. Florence Verdin, (Record, direct questions 14 to 35, and 58, pp. 143 to 146, 148.)

Second. Professor P. H. Van der Weyde. (Record, direct questions 4 to 17; cross, 120, 122, 128, pp. 150, 151, 168, 169.)

Third. Professor Ogden Doremus. (Record, direct questions 2 to 11; cross, 33; pp. 173, 177.)

Two of these witnesses are now, and have long been engaged practically in the business of manufacturing fat acids and glycerine, and the other two are, and have been, professors of chemistry. They have all made carefully conducted experiments with the process first described in plaintiff's patent, at the temperature of melting lead, and even down to the temperature of melting tin. Some of these experiments were conducted in precise conformity with the patent, with the vessel full of the mixture, and some with the vessel about two-thirds full of the mixture, and in every instance the process was a failure, acroleine in considerable quantity having been produced. And they show clearly that such must inevitably be the result at the temperatures named in plaintiff's patent, because at those temperatures the elements of glycerine are changed into the acrid substance called acroleine. They concur also in showing that the products are greatly deteriorated by the presence of acroleine.

The testimony of these witnesses was so conclusive that appellee deemed it essential to try and rebut it, and for that purpose recalled Professor Booth and Dr. Genth, both of whom testified to the experiment with a horizontal tube partly filled, to which reference has been made.

Although, as already shown, the experiments made with the coiled apparatus were not made in conformity with the patent, and appellee failed to prove thereby a practical mode of applying his invention to practice, still

it was deemed important, on the part of appellant, to have that apparatus accurately tested.

Appellant's witnesses, who first testified to tests made with the coiled apparatus, the preferred mode of application described in the patent, and of its utter failure, are:

William Thomas (Record, direct questions 1 to 13, 14 to 23, p. 190.)

Joseph T. Verdin (Record, direct inters. 1 to 15, p. 178.)

David Thain, formerly a candle manufacturer (Record, direct inters. 1 to 9, p. 212.)

John H. Smith, formerly engaged in the manufacture of candles and fat acids (Record, direct inters. 1 to 15, p. 219.)

Florence Verdin (Record, direct inters. 1 to 10, p. 225.)

By all these witnesses it was conclusively proved, that with a coiled apparatus like that described and represented in the Tilghman patent, and operated in accordance with the description in the patent, they utterly failed to produce free fat acids and solution of glycerine, without being tainted and materially injured by the presence of acroleine, and yet the fats were not completely decomposed.

Before the Master additional evidence was put in on the part of appellant to prove, that by the preferred mode of working the process described in the patent it was impossible practically to produce fatty acids and solution of glycerine. This additional evidence is from men of long experience in the business of decomposing fats in the manufacture of fatty acids and glycerine.

The witnesses in question are: Charles T. Jones, a manufacturer of fatty acids and glycerine, and a licensee of Tilghman (Record, p. 324). He testifies that he is familiar with the Tilghman patent, and that he witnessed the tests made at Shillito's factory with the coiled apparatus put up there by Verdin. The apparatus was heated up to the heat of melting lead. That the mixture of

fat and water was forced through it at the rate named in the patent. That the product seemed to him to be a mixture of neutral fat, fat acids and acroleine, the fat acids strongly impregnated with the acroleine, dark and unfit to make good candles. (Record, p. 324, direct inters. 1, 4, 5 and 6.)

George Shillito (Record, p. 331.) This witness testifies that he has been engaged in the business since 1850. That he witnessed the working of the coiled apparatus which was put up in his establishment for trial (proved by other witnesses to be the same as tried in New York in 1864.) He described how it was worked and the result. That the fat was only partially decomposed and the glycerine destroyed. That there was a strong smell of acroleine, which affected nearly every one present. That such an apparatus is of no earthly use to anybody, and cannot be practically used for the manufacture of fatty acids. That he manufactures by what he calls the lime process in a close tank, with one-third water and seven pounds of lime to one hundred of fat, and at a temperature due to heat at from 80 to 85 pounds pressure, and that superheated steam passes directly into the tank. (Direct Inters. 1, 3, 4, 8, 12, 13, 16, 17.)

Michael Werks testifies, that he has thirty-six years experience in the business of manufacturing soap and candles. That he read the Tilghman patent in 1858 or 1859, and made an experiment with a coil of pipes about 140 to 150 feet in length and half an inch internal diameter, and when highly heated he pumped through it half fat and half water, and obtained from it only fat and water, without any material change. Tried this several times. That he witnessed the trials with the Tilghman coil apparatus at Shillito's factory, put up under the superintendence of Florence Verdin. Describes it and the working of it as in the patent. That what was discharged was part fat acid and water, which had an offensive smell and a sour taste. Tried it two hours with no other result. That he was present also when it was tried the second time. After the melting

point of lead there was the same result, except that the smell was more offensive, and the fat grew darker. That the glycerine was formed by the partial decomposition of the fat, and spoiled by the production of acroline. That the product has less value than the original fat. He further testifies that, in Paris, in 1860, he saw the Wright & Fouché method in use, which he describes like appellants, and that by that, steam rises from the boiler, passes over into the vessel containing the fat, and decomposes it into fatty acids and glycerine, but cannot state what heat was used (Record, p. 335, Direct Inters. 1 to 8).

Charles H. Grant testifies that he saw the coiled appatus tested in Cincinnati, and that the decomposition was very imperfect, and the smell offensive; and the products totally unfit for the manufacture of candles in competition with any process (Record, p. 362, Direct Inters. 1, 2, 26).

The witnesses so far referred to, as to the working of the coiled apparatus at Shillito's factory, did not attempt to specify the precise details of the apparatus.

Their testimony was as to the results as practical manufacturers of fatty acids and glycerine, most of them being licensees of appellee.

That the apparatus was the same as the one testified to by the witnesses in the record before the Court on final hearing, and constructed and operated in exact accordance with the description in the Tilghman patent, is proved by:

Florence Verdin (Record, p. 340, Direct Inters. 2 to 16).

Roland G. Mitchell (Record, p. 351, Direct Inters. 25,26, 27).

As the evidence was conclusive to establish the fact that, by the preferred apparatus described in the patent, the process could not be practically worked on the part of complainant below, drawings and descriptions were put in evidence and testified to by Prof. Booth as repre-

senting apparatus known prior to the date of the patent at issue.

The purpose for which these drawings were put in evidence is obvious, as the patentee, in his specification, before describing the preferred form of apparatus in which his process is to be worked, says that the mixture of fat and water "may be placed in any convenient vessel in which it can be heated to the melting point of lead until the operation is completed," it will be contended, on the part of appellee, that under that general statement the patentee contemplated the use of any apparatus known at that time to the arts, and that if the process could not be practically worked in the apparatus specially described in the patent, and it could be successfully worked in "any convenient vessel" then known, such, for instance, as some of those so put in evidence, that the patent could not be held to be void for the want of a sufficient description of the means for working the process. And further, that if among the apparatus so previously known there should be found one which causes a liquid to circulate, as in the apparatus used by appellant, that that fact would settle the question of infringement.

There are two distinct and conclusive answers to these assumptions:

First. That the patentee never contemplated the use of any such apparatus is established by the fact that after failing to work the process in the preferred apparatus described in the patent in two series of experiments, the first series occupying six months, in 1854 or 1855, and the second series for three months in 1858; he never tried any of the appratus so previously known and put in evidence, for if he had contemplated the use of any of them, he would have tried them.

Second. As two of the leading conditions of the patented process are that the vessel shall be entirely full of the mixture of fat and water, which excludes the idea of circulation, and that the fat and water shall be maintained during the process in a state of thorough ad-

mixture, it cannot be believed that the patentee intended by the expression "any convenient vessel," to use either a vessel which was not to be filled with the mixture of fat and water, or an apparatus in which, by the law of its organization, should cause the water to circulate through the charge of fat.

POINT III.

THE PATENT IS VOID FOR THE WANT OF NOVELTY, UNLESS THE CLAIM BE LIMITED TO THE PROCESS AS PRESENTED UNDER THE FIRST POINT.

The patentee, Tilghman, was not the first to discover the chemical fact that water at a high temperature and pressure would decompose fatty and oily bodies of vegetable and animal origin, and produce there from fatty acids and solution of glycerine.

The Court below found, as a fact proven—what is not sustained by the evidence—that Tilghman, the patentee, was the first to discover the chemical fact that fats and oils could be decomposed, and fatty acids and solution of glycerine produced by highly heated water.

The dissenting opinion of that learned and distinguished Judge, in Le Roy and Smith *vs.* Tatham, 41, Howard, p. 156, cannot fail to indicate how his mind would be influenced in the legal construction of the patent at issue by the belief that the patentee was the first and true discoverer of that chemical fact.

On the assumption, however, that the patentee was the first to discover that chemical fact, he could not patent it. All that he could patent was the invention of some process for effecting the decomposition by water.

O'Reilly *vs.* Morse, 15 Howard, p. 62.

But the patentee was not the first to make that discovery.

The only person who could positively know the fact was the patentee.

It might have been discovered before by some other person, but he alone could know whether he did himself actually make the discovery.

That he was not the discoverer may be inferred from the fact that it is not asserted in the patent. All that appears in the patent is, that the patentee claims to have invented "a new and improved mode of treating fatty and oily bodies," and that his invention "consists of a process for producing free fat acids and solution of glycerine from fatty and oily bodies of animal and vegetable origin;" and that the claims, "the manufacturing of fat acids and glycerine from fatty bodies by the action of water," (not broadly, but) "at a *high temperature and pressure*;" having in the description asserted that the change from fats to fatty acids and glycerine takes place at a temperature varying from 510° to 610° F., according to the quality of the fat. He was examined as a witness in this case, and could have been, but was not, questioned as to being the discoverer of that chemical fact. He was then, and is now, a chemist by profession, and the omission of so important a fact in the specification cannot be attributed to ignorance.

Long prior to the alleged invention in the patent at issue, the chemical fact of the decomposition of fatty and oily bodies, and the production therefrom of fatty acids and glycerine by heat and the elements of water, was known to the literature of chemistry.

The change of fat into fatty acids by water and heat was announced to the scientific world as early as 1823, by the celebrated chemist, Prof. Faraday, in a paper published in the *London Journal of Science.*

Defendants' Exhibits A, B, C, D, and specially E.

(Record, pp. 383 to 389, specially p. 388.)

See the testimony of
Florence Verdin (Record, Ints. 17 to 21, p. 392).
Prof. Van Der Weyde (Record, Ints. 2 to 11, pp. 395, 396).

The decomposition of castor oil into fatty acids and glycerine by water and heat in the boiler of a water-barometer, was observed by Prof. Daniel, a chemist in London, and the fact published in 1832, in the *Philosophical Transactions of the Royal Society of London.*
See defendants' Exhibit F.
(Record, p. 389.)

And the testimony of
Florence Verdin (Record, Ints. 24, 25, p. 392.)
Prof. Van Der Weyde (Record, Ints. 2 to 11, p. 395.)

The announcement of the discovery by Faraday, above referred to, was transferred to other scientific journals, and, among others, to Dingler's *Polytechnic Journal*, published at Stuttgard, Germany, in 1823.

This statement reached Mr. Werks, a manufacturer of candles, in Cincinnati, and in 1843 or 1844, at his suggestion, Florence Verdin then made a trial of it, by exposing fat and water alone to a temperature of about 300°, in a close vessel, for twenty-four hours, but it was not practical, for the want of some means for causing the water to circulate through the fat.

Since the commencement of this suit he has, by suitable tests, proved that at that temperature, with circulation, the process is practical, and without circulation it is not suitable for the practical business of manufacturing fatty acids and glycerine.
(Record, Ints. 49, 50, 51, 71, pp. 147, 149.)

That the presence of water or steam was necessary to the production of glycerine in the decomposition of fats, was known long prior to 1854, it was used for that purpose in the old saponifying process. This cannot be denied, and was admitted even by Prof. Booth, on cross-examination.
(Record, Cross Ints. 95, 96, p. 45.)

The only fact not generally recognized prior to 1823, was whether water (oxyde of hydrogen) was sufficiently strong, as a base, to remove the oxide of glyceril, and acidify the stearine, margarine and oleine; if so it followed, from what was known before, that it would hydrate the glyceril, and produce glycerine.

Dubrunfaut obtained a patent in France in 1841, in which he described the subjecting of palm oil at the temperature of ebullition to a current of divided vapor of matter, for the distillation of the developed fatty acids. And in another passage he points out the importance of applying the steam to the fat in numerous small jets.

Defendant's Exhibit 4, (Record pp. 233, 234).

And in 1850 Professor Scharling published a paper in the Journal of Practical Chemistry, Lespsic, upon the application of the superheated vapors of water.

In this paper the fact is announced that fats and oils are decomposed, and fat acids produced by superheated vapors of water. He describes the means employed, and states that the decomposition was effected by the vapor of water in a similar manner as by the strong bases; and, also, that not the slightest trace of acryl combinations were produced.

Defendant's Exhibit No. 10, (Record pp. 237, 238).

In an early part of this brief it has been pointed out that steam, whether saturated or superheated, is simply water expanded, and of the same chemical constitution—and that when the action required is purely chemical, it is equally applicable in either of the three forms. From this it follows that if steam at a high temperature will decompose fats, and produce fatty acids, it must also produce glycerine.

After the publications of Dubrunfaut and Scharling, in 1841 and in 1850, independently of the prior publications before referred to, it cannot, in reason, be said that in 1853 or 1854, Tilghman was the first to discover the

chemical fact that heat and water would decompose fats and produce from them fat acids and glycerine.

The experts, on the part of appellee, all, except Prof. Gibbs, testify that they do not find in the Exhibits Nos. 4 and No. 10, a description of the use of the same agent as in the Tilghman Patent, viz., liquid water.

But Professor Gibbs was not so pliant to the wishes of appellee, and says that in Exhibit No. 4 (Dubrunfaut), he does not find prior knowledge of Tilghman's process, but that he finds abstract chemical principles which are the same as in Tilghman's process, and the mention of the production of fat acids and glycerine.

(Record, Ints. 10, 11, p. 11.)

And as to Exhibit 10 (Scharling), Prof. Gibbs makes, in substance, the same answer, and that there can be no doubt that the same results are produced as by Tilghman's process.

(Record, Ints. 28, 29 and 30, p. 13.)

As processes, Prof. Gibbs is of the opinion that the Tilghman process is different from the use of steam, as presented in defendant's Exhibits 4 and 10, but concludes that perhaps this is a point of law rather than of science.

(Record, pp. 246, 247.)

Prof. Booth made an experiment in the presence of Prof. Rogers, to prove that the decomposition of fats by superheated steam would not answer the purpose, on account of the destruction of the glycerine. As made by Prof. Booth, this experiment was not in accordance with the descriptions in the Exhibits, and so made as to insure the production of acroline.

The two Professors did not know at what temperature the retort was heated, or the temperature of the steam applied. Instead of applying the steam in numerous jets, he applied it in a single jet, and chocked the discharge of the vaporized glycerine, thereby insuring its

destruction into acroline by too long an exposure to a high temperature.

See testimony of Prof. Booth:
(Record, Ints. 22 to 27, 32, pp. 30, 32, cross 90 to 99.)
Prof. Rogers:
(Record, Int. 12, p. 57; cross 13 to 19.)

Prof. Booth applied the steam in a single jet in direct disregard of the instructions of Dubrunfaut, who says that "the reaction produced by the vapor of water upon the fatty body is favored by the division of the vapor; hence it is necessary to use apparati which will give this vapor in small jets into the fatty body." Even without this instruction, no chemist, under proper influences, would have failed to diffuse the steam so that the supply should be abundant, and equally supplied to the whole charge of the fat under treatment.

They did not try the process as described by Scharling, Exhibit No. 10.

On the part of appellant, conclusive evidence was furnished to contradict Professors Booth and Rogers, and to establish that the decomposition of fats and production of fatty acids and glycerine by superheated steam is not only practical, but far superior to the process described and claimed in appellee's patent.

The process described by Scharling was tested by appellant's experts, and fat acids and glycerine successfully produced, and of good qualities.

See testimony of Florence Verdin, (Record, ints. 15 to 28, pp. 189 to 192.)

But that superheated steam will successfully decompose fats, and produce therefrom free fat acids and glycerine, with evolving acroleine, is conclusively proved by evidence put in on the part of appellee.

See patent granted in England, July 22d, 1854, to Wilson and Payne.
(Record, pp. 87 to 89.)

And also two papers, published by G. F. Wilson, one in Sept., 1855, and the other in January 1856 (Record, pp. 89 to 97; specially pp. 87, 88, 93, 96). These publications establish the following facts: *First*, that superheated steam, for the purpose in question, is equivalent to highly heated liquid water under pressure, at the range of temperatures named in appellee's patent.

Second. That Professors Booth and Rogers made an improper experiment of the Dubrunfaut process; and

Third. That the Tilghman process was intended to be worked at the high temperatures named in the patent.

This alleged discovery, attributed by the Court below to Tilghman, was only one of relative strength of chemical affinities; that is, of relative strength of bases.

In fats and oils the base to the fatty acids is oxide of glyceril. It was long before known that lime, potash, soda, all oxides which were known as strong bases, could drive out and replace the oxide of glyceril, water being present to hydrate the glyceril and change it into glycerine, and all that was required to be ascertained was whether water (oxide of hydrogen) was a stronger base than oxide of glyceril.

If the discovery of Faraday, in 1823, and of Daniel, in 1832, was not sufficient to establish the fact that heated water will decompose fats and produce fat acids and glycerine, the publications of Dubrunfaut, in 1841, and of Scharling, in 1850, establish the fact beyond doubt.

Gay Sussac and Chevreul obtained a patent in France as early as 1825, in which they state the fact that by boiling at a temperature due to a pressure of several atmospheres presents great advantages over that which is commonly practiced at the sole pressure of the atmosphere, saponification having been operated with the smallest possible quantity of alkali.

Defendants' Exhibit 18, (Record, pp. 244, 245).

As they were enabled by the increase of temperature to

destruction into acroline by too long an exposure to a high temperature.

See testimony of Prof. Booth:
(Record, Ints. 22 to 27, 32, pp. 30, 32, cross 90 to 99.)
Prof. Rogers:
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The process described by Scharling was tested by appellant's experts, and fat acids and glycerine successfully produced, and of good qualities.

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Third. That the Tilghman process was intended to be worked at the high temperatures named in the patent.

This alleged discovery, attributed by the Court below to Tilghman, was only one of relative strength of chemical affinities; that is, of relative strength of bases.

In fats and oils the base to the fatty acids is oxide of glyceril. It was long before known that lime, potash, soda, all oxides which were known as strong bases, could drive out and replace the oxide of glyceril, water being present to hydrate the glyceril and change it into glycerine, and all that was required to be ascertained was whether water (oxide of hydrogen) was a stronger base than oxide of glyceril.

If the discovery of Faraday, in 1823, and of Daniel, in 1832, was not sufficient to establish the fact that heated water will decompose fats and produce fat acids and glycerine, the publications of Dubrunfaut, in 1841, and of Scharling, in 1850, establish the fact beyond doubt.

Gay Sussac and Chevreul obtained a patent in France as early as 1825, in which they state the fact that by boiling at a temperature due to a pressure of several atmospheres presents great advantages over that which is commonly practiced at the sole pressure of the atmosphere, saponification having been operated with the smallest possible quantity of alkali.

Defendants' Exhibit 18, (Record, pp. 244, 245).

As they were enabled by the increase of temperature to

reduce the proportion of lime used in the old saponifying process, it proved beyond doubt that the water present acted as a base to replace the part of the lime which would have been required in boiling at the pressure of the atmosphere.

Appellee's experts testify that this Exhibit does not show a want of novelty in the Tilghman process. Prof. Booth gives as a reason for this, that by the process described by Gay Sussac and Chevreul, a soap is formed, and that afterwards the fat acids have to be separated from the alkali by an after process, while by the Tilghman process a soap is not formed (Record, p. 36).

That is all true, but still the fact is established that as early as 1825, these two French chemists asserted the fact that water, with increased heat, was, as a base, equivalent to lime. But this Exhibit 18 plays a striking part in this litigation.

In the suits in Cincinnati, this patentee, Tilghman, has succeeded in holding parties as infringers of his patent for doing the very thing which is presented in this Exhibit, namely, using less lime by boiling under the pressure of several atmospheres, but far below the temperature named in his patent, under the plea that so far as they were enabled to reduce the proportion of lime, a part of the fat acids obtained were acidified by hot water and pressure. See testimony of Michael Works (Record, p. 337)

In the old saponifying process, boiling at the pressure of the atmosphere, twelve to fourteen pounds of lime are required to the hundred pounds of fat, but Michael Works, by boiling under a pressure of several atmospheres, (as Gay Sussac and Chevreul, published to the world in 1825,) used but seven pounds of lime. He made a lime soap, as the French chemists did, and like them had to use an after process to separate the alkali from the fat acids, and yet appellee, who as a chemist must have been acquainted with this French patent of 1825, not only made Michael Works, but all others who boiled at a higher

temperature with less lime, pay tribute to this patent. Prof. Booth and the other Philadelphia chemists testified as experts in the suits in Cincinnati.

Prof. Booth testified that in the standard works on chemistry, Tilghman is given the credit of having been the first to make the discovery that water, under heat and pressure, will decompose fats.

In this he is contradicted by Florence Verdin, and by Prof. Van der Weyde. (Record, Ints. 21 and 24, p. 392). Record, Ints. 10 and 11, p. 396.

Argument of Point III.

The change of fat into fatty acids by water and heat was announced by the celebrated English chemist, Faraday, as early as 1823, in a paper published in the London *Journal of Science.*

Perkins, in his steam engine, used Russia tallow and olive oil to lubricate the piston, and the substance produced therefrom was examined and analyzed by Faraday, who concluded that it was fatty acids. Defendant's Exhibits A, B, C, D and E.
(Record, defendant's Exhibit E, p. 388.)

Florence Verdin testifies that this account shows that the fat and oil were decomposed and fatty acids and glycerine produced by the hot water in the steam generator of the Perkins engine. (Record, ints. 17 to 21, p. 392.)

Prof. Van der Weyde testifies to the same effect. (Record, ints. 2 to 11, pp. 395, 396.)

The decomposition of castor oil into fatty acids and glycerine by water and heat, in the boiler of a water barometer, was observed by Prof. Daniel, of London, a chemist, and the fact announced by him in a paper published, in 1832, in the *Philosophical Transactions of the Royal Society of London.* (Exhibit F, Record, p. 389.)

See the testimony of Florence Verdin. (Record, ints. 24 and 25, p. 392.)

And of Prof. Van der Weyde. (Record, ints. 2 to 11, p. 395.)

In 1843 or 1844, Florence Verdin made an experiment to decompose fats for the production of fatty acids and glycerine. The fat and water were put in an iron vessel, two feet long and twenty inches diameter, and therein heated to about 300° F., under a pressure of sixty to seventy pounds to the square inch, continued for twenty-four hours.

This experiment was made at the suggestion of M. Werks, in Cincinnati, who said that he had it from a German chemist, who said that he had seen it in some work. And the witness subsequently found it in *Dingler's Polytechnic Journal*, published in 1823, in Suttgardt, Germany, vol. 12, page 466. The witness quotes the passage in question. It will be found (Record, p. 378), and is as follows, viz:

"On the change of fat by water, heat and pressure, which was observed by Mr. Perkins in his steam cylinder, for which he uses equal parts of Russia tallow and olive oil, for the lubrication of the piston, and which the renowned chemist, Faraday, examined (by analysis), an interesting notice of which will be found in the *Philosophical Magazine*, Oct., 1823, p. 318, from the *Journal of Science*, XVI., p. 172, which, duly considered, probably may yet lead to many useful results."

(Record, Ints. 49, 50, 51, p. 147 and, to 13, p. 378.)

In view of such publications, all within the reach of every chemist and of appellee, who is a chemist, it cannot be said that he was the first to discover the chemical fact that fats and oils can be decomposed and fatty acids and glycerine produced by water, heat and pressure.

Long before these publications it was known that, in the decomposition of fats in the presence of water, glycerine was produced. It was so produced in the saponifying process.

The only question was as to the production of the fatty acids by water as a base.

A patent was granted in France to Pierre Dubrunfaut, August 28th, 1841, in which is described, "the decomposition of fatty bodies, by subjecting such bodies to the action of a divided current of the vapor of water—see defendant's Exhibit No. 4. (Record, pp. 233, 234.)

And in the Journal for Practical Chemistry, published at Leipsic, 1850, there was published a paper by Professor Scharling, on the application of the superheated vapor of water. In this paper, the chemical fact is announced that fatty bodies are decomposed by the superheated vapors of water alone, in a similar manner as by the strong bases. See defendant's Exhibit No. 10 (Record, pp. 237, 238).

It has already been shown that by the old saponifying process, with lime water, the lime, which is an oxide of colcium, combines with the stearine, margarine and oleine, forming a steareate of lime, margarate of lime and an oleate of lime; the oxide of calcium as a base taking the place of the oxide of lypil or glyceril, while at the same time the glyceril combines with the elements of water forming glycerine.

Professor Gibbs, one of appellee's chemical experts, says that in effecting this decomposition, any other base may be substituted for the oxide of lypil or glyceril, such as lime, soda, potash, water, or almost any other oxide. Record, p. 246.)

Water is an oxide of hydrogen, and as the elements of water in the old saponifying process, hydrated the glyceril to produce glycerine, and Dubrunfaut, in 1841, said, that the vapor of water would oxidize the other ingredients of the fat and produce the fatty acids; and Professor Scharling, in 1850, published to the world that by his experiments he had tested the re-action of the superheated vapor of water and found that the oils are decomposed by it in a similar manner as by the strong bases, it

followed that water as a base for the decomposition of fats, and the production of fat acids and glycerine could be substituted for the stronger bases previously used. In view of this it become necessary on the part of appellee, to try to overcome the force of this reasonable deduction.

Prof. Booth, ever ready in an emergency, was called into service for that purpose.

He made an experiment in the presence of Prof. Rogers as a passive looker on. By this experiment they were enabled to swear, not to the faithfulness of the test, but to the fact that, as tried, the process was worthless on account of the production of acroline by reason of the destruction of the glycerine.

See testimony of Prof. Booth (Record, Ints. 22 to 27, 37, pp. 30, 32, Cross Ints. 90 to 89).

And of Prof. Rogers, (Record, Ints. 12, p. 57, Cross 13 to 19).

This experiment was made with half a pound of fat in a retort of the capacity of one pint, heated by gas burners below, and the superheated steam applied to the fat by a single pipe introduced through the beaker of the retort. No means were employed to ascertain the temperature to which the retort was heated, nor the temperature of the superheated steam applied. In short the experiment was made not only in disregard of the instructions of Dubrunfaut as well as of Scharling, but as if with the intent to make it a failure.

Glycerine distils, that is, escapes as a vapor, at a temperature above three hundred degrees (F.). In view of this, reason suggests that the vessel in which the process is worked shall have a free and open discharge. Instead of this the beaker of the retort must have been nearly closed, for the steam was introduced by a steam pipe inserted in the beaker of the retort; this must have seriously checked the discharge of the glycerine and retained it in the retort exposed to the high temperature of the bottom of the retort, which was heated by gas burners. No better mode could have been adopted to change the glycerine into acroline. And besides, the

steam was introduced in a single jet, in disregard of the instructions given in Exhibit 4, in which Dubrunfaut says: "The reaction produced by the vapors of water upon the fatty body is favored by the *division of the vapors*, hence it is necessary to use apparati which give this vapor in small jects into the fatty body." The object of Dubrunfaut was to give an abundant supply of steam to all parts of the fat, so as to oxydise the fats and hydrate the glycerine. But Prof. Booth, blind not only to the instructions of Dubrunfaut, but to the dictates of chemical reasoning, supplied so little steam that the reaction could only be partial, and hence the production of acroline.

Prof. Gibbs, although examined as an expert on the part of Tilghman, could not be drawn into such a chemical absurdity.

He testified that, although Dubrunfaut, in Exhibit No. 4, does not mention the use of liquid water, he does mention the production of fat acids and solution of glycerine. And when asked whether Scharling, in Exhibit 10, mentions the use of the same agent and the production of the same results, as in the Tilghman patent, answered: "Scharling does not mention the use of the same agent" (meaning liquid water), "nor distinctly mention the production of the same results; but it cannot be doubted that the same results are obtained."

(Record, direct ints. 10 to 14 and 28, pp. 11–13.)

And in his opinion, after referring to the state of the art, and that steam had been known for this purpose prior to Tilghman's alleged invention, he says: "I do not find that any one, before Tilghman, used water heated to a high temperature in a close boiler to decompose parts. I find that steam, heated to a high temperature, with and without lime, has been used for this purpose, but that distillation in a current of steam, at a high temperature, is employed. So far as the mere act of decomposition is concerned, I consider saponification by steam to be identical with saponification by water; but, on the

other hand, I hold that decomposing fats by water, in a *close boiler* at a *high temperature*, is not, as a process, the same as distilling the fat in a current of high steam, even though the chemical actions are the same in both cases." He then adds: "*This, perhaps, is a point of law rather than of science.*"

(Record, pp. 246, 247.)

The Scharling process was tested by appellant's experts and was quite successful. (See Florence Verden's testimony. Record, Ints. 15 to 28, pp. 189 to 192.)

As a question of discovery, the testimony of Prof. Gibbs, agreeing with the testimony of the experts on the part of appellant, throws the strong weight of evidence, against the finding of the Court below, that Tilghman was the first to discover that fats could be decomposed, and fat acids and glycerine produced by heat and water.

The difference between saponification by steam and saponification by water, in view of the state of the art, is a question of law and not of science.

Experts may inform the Court as to whether, in the decomposition of fats, steam has or has not the same chemical action as a re-agent. If it has, then, in judgment of law, steam and water are equivalents for this purpose.

But the most conclusive evidence to contradict and condemn the experiment of Prof. Booth, as to the use of superheated steam, was put in on the part of appellee Tilghman.

This proof is found in a paper by G. F. Wilson, "On the manufactures of Price's Patent Candle Company," published in January, 1856.

(Record, pp. 90 to 97.)

This paper was put in evidence on the part of appellee (Tilghman).

In it, the author, after alluding to the process of Tilghman, and that its commercial value had not then been tested, and that it was to be worked in a coil of pipe heated to 612° F., and under a pressure of about 2,000 pounds to the square inch, says, in substance, that he went with his assistant chemist to see the Tilghman's coil apparatus, and that it struck him "that steam passed into the fat at a high temperature should effect by a gentle process what Mr. Tilghman aimed at effecting by a violent process—the resolving of the neutral fat into glycerine and fat acids. We proved that this was so, and that the glycerine distilled over in company with the fat acids, but no longer combined with them." (Record, p. 96.)

In this same paper (p. 93), he says that in 1843 he found that Dubrunfaut had previously taken a patent in France and in England, although he omits to say that it was for this identical use of steam, viz., to effect, by a gentle process, what Tilghman sought to effect, twelve years after, by a violent process. In another paper, by this same person, published in September, 1855, and also put in evidence, on the part of appellee (Tilghman), Wilson says, "in our new process the only chemical agents employed for decomposing the neutral fat and separating its glycerine, are steam and heat." (Record, p. 90.)

Wilson and Payne obtained a patent in England, in July, 1854, for this process (Record, pp. 87, 88). It is the same as that described by Dubrunfaut in 1841, and by Scharling in 1850, but described with more detail. And, on examination, it will be seen that Prof. Booth, in his alleged test of the Dubrunfaut process, was entirely at fault in the mode of making the test, for instead of giving an ample supply of steam in numerous jets, and being careful not to carry the heat beyond 600° F., he introduced the steam in a single jet, and did not even know the temperature of the retort, or of the steam introduced. It is respectfully submitted that such *ex parte* tests, not made in accordance with the description, and contrary to the dictates of reason, should have no weight.

Two eminent chemists, Guy Lussac and Chevreul, patented a process in France in 1825. (Defendant's Exhibit No. 18; Record, p. 244.)

This process is entitled, "for the application of the stearic and margaric acids to illuminating purposes," and not, as intimated by the testimony of appellee's experts, for making soap.

In this French patent, Gay Sussac and Chevreul first describe the obtaining of the fats by what is known as the old saponifying process—decomposing the fats by boiling them in lime water at 212° F. pressure of the atmosphere, which produces what is known as a lime soap, and solution of glycerine, the lime combining with the stearine, margarine, and oleine, changing them into steareate of lime, &c., and the water hydrating the glyceril, to form glycerine. They say, "We saponify the fatty bodies *destined for illumination*, or which we will allow to remain in the state of soap, either at the ordinary temperature or ebullition with the sole pressure of the atmosphere," which means 212° F., "or at a more elevated temperature, with a pressure of several atmospheres," which means, according to common reason, a much higher temperature than 212° F., and which can only be effected in a close vessel. And then they add: "We have found that the saponification executed in the latter manner presents greater advantages over that which is commonly practiced with the sole pressure of the atmosphere. The saponifiation having been operated with the smallest possible quantity of alkali, we separate the acids, &c.

Here is a clear announcement of the fact, as early as 1825, that by boiling under a pressure of several atmospheres instead of the common practice at the pressure of one atmosphere, a smaller proportion of alkali (lime) will be required.

On the part of appellee another extract from this French patent was introduced, marked complainant's Exhibit A, A.
(Record, p. 77.)

This extract, Exhibit A, A, gives a description of the after process of separating the lime (or other alkali) to render the fat acids free, as it is termed.

On this, appellee's experts were called to testify.

Prof. Booth admits that the purpose of the patentees is the application of stearic and margaric acids to illuminating purposes, and then says, "in which they state the first process always to be making a soap of the fat by acting on it with an alkali, potassa, or soda, and subsequently separating the acid. They further state that the operation of soap making may be performed at ordinary temperatures and pressures, but that the operation of soap making at a more elevated temperature, with a pressure of several atmospheres presents greater advantages. And after stating that Exhibit A, A, gives the method of decomposing the soap, so as to get fat acids, adds that Tilghman's process has nothing to do with the making of soap from fats, but makes fat acids and glycerine from fats by the direct action of water.

(Record, p. 36.)

And Dr. Ghent, in his comparative table, says: Gay Lussac and Chevreul process produces a neutral soap by using enough alkali to saturate all the fatty acids contained in the fat, and produces no free fatty acids directly. Tilghman produces no soap.

(Record, p. 73, division III.)

Any one reading this testimony without knowledge of elementary chemistry, could not fail to come to the conclusion that the process of Gay Sussac, and Chevreul was for the production of soap, when in fact it is a process for obtaining stearic and margaric acids, the two of the free fat acids required for making candles, the oleic acids being usually pressed out as not being suitable for candles.

Now, whenever fats are decomposed by lime, soda, or potash, dissolved in water, that part of the product which combines with the lime (or equivalent) is termed

a lime soap, because in that condition it can be made into soap, but it is only an intermediate condition in the process for producing free fat acids. And these experts ought to have known that their testimony was calculated to mislead.

But Dr. Ghent's table is directly at variance with the truth, for he says, "produces a neutral soap, by using enough alkalki to saturate all the fatty acids contained in the fat," while the clear import of the language of Exhibit 18, is. that by boiling, at a more elevated temperature, due to a pressure of several atmospheres, the proportion of alkalki is reduced. That, and that alone, could be the advantage of boiling at the pressure of the atmosphere.

These very experts were examined in the suits of Tilghman *vs.* Michael Werks, tried in Cincinnati. In those suits the charge of infringement was, that Werks used about seven per cent. of lime, instead of thirteen or fourteen, and boiled at a pressure of several atmospheres instead of the old saponifying process, at the pressure of the atmosphere.

It was admitted that, as he used some lime, but not enough to saturate all the fat acids, he produced a lime soap, from which the alkali had to be removed by the usual sulphuric acid process. But on the part of Tilghman, and by the aid of these very experts, it was contended that some free fat acid was produced by the water, and to that extent he was held by the Court to be an infringer.

Thus, it will be seen that Tilghman, who must have been acquainted with this Guy Sussac and Chevreul patent of 1825, by the aid of these experts led the Court to hold Werks as an infringer of his patent for doing the very thing which the French chemists presented to the world before Tilghman was born. And now that the suit is against a party who does not use lime or any other alkali, these very chemists testify that this French patent of 1825 does not show a want of novelty in appellee's

patent, because he does not use lime, but uses only water.

It is respectfully submitted that, in view of the state of the art in evidence, the patent at issue is either void for want of novelty, or the claim must be limited to the process as described, and as presented in the first point.

POINT IV.

DOES THE PROCESS USED BY APPELLANT INFRINGE THE PATENT AT ISSUE?

It will be contended on the part of the appellant that it does not.

The process practiced by appellant is under Letters Patent granted Wright and Fouché, dated Jan. 25th, 1859, the same process having been patented by them in France in 1857. (Record. p. 229.)

If the claim of the patent at issue should be construed as presented under Point I. of this brief, it is respectfully submitted that appellant cannot be held to have infringed, because—

First. He has never employed substantially the range of temperature required in the patent at issue, viz., from 510° to 610° F., the temperature which alone will decompose fats; but instead, the temperature used by him has been limited to 374° F., far below the temperature required to decompose fats alone.

Second. Instead of the dangerous pressure resulting from the temperature required in the patent at issue, nearly 2,000 pounds to the square inch, he has not used a pressure greater than 180 pounds to the square inch.

Third.—He has never worked his process in a vessel entirely full of fat and water, to prevent the water from evaporating, as required in the patent at issue, but, on the contrary, has always left abundant space for the generation of steam, and his process has always been worked with steam and water.

Fourth.—He has never mixed the fat and water before charging it into the apparatus, and never permitted them to be in a state of admixture during the working of the process, as required in the patent at issue; but, instead, the fat has been separately charged in one vessel, and the water in a separate boiler, the two being so connected by pipes that the steam generated in the boiler passed into the vessel containing the fat and above the charge, the steam and water of condensation then filtered through the charge of fat, and down into the boiler, carrying away with it what glycerine may have been formed.

The two processes are substantially different, and effect the decomposition of fats by modes of operation which are substantially different. It is by reason of this substantially different mode of operation, that appellant has been enabled to effectually decompose fats, and produce therefrom free fat acids and glycerine of superior qualities; while the mode of operation described in the patent never has been and never can be worked practically.

(Record, ints. 40 to 49, p. 146.)
(Record, pp. 352, 353.)

Appellee never succeeded in practically decomposing fats and obtaining free fat acids and glycerine until after Wright and Fouché invented that mode of operation of causing the water to circulate through the fat, and after that, in 1860, appellee, by an imperfect application of this mode of operation obtained a partial success, but he never entirely succeeded until 1863, when he adopted the entire mode of operation of Wright and Fouché by applying water and steam to the upper part of the charge, and using a pump to draw the water from the bottom and discharge it on the top, so as to cause a

constant circulation through the fat from the top to the bottom, using a mechanical pump instead of heat to effect the circulation.

POINT V.

IF THE COURT SHALL HOLD THE PATENT AT ISSUE TO BE VALID, AND APPELLANT TO HAVE INFRINGED, THEN HAS APPELLEE PROVED THAT ANY OF THE SAVINGS, GAINS OR PROFITS REALIZED BY APPELLANT HAVE BEEN DUE TO THE USE OF THE PROCESS CLAIMED IN THE PATENT AT ISSUE?

The Court below erred—

First. In finding that the cost of the lime and sulphuric acid, which would have been used by the old saponifying process in treating the quantity of fat worked by appellant, was due to the use of the process claimed in the patent at issue.

Second. That the saving of fat which is wasted by the saponifying process was due to the use of the invention claimed in the patent at issue.

Third. That the improved quality of the glycerine, produced by appellant, has been due to the use of the invention claimed in the patent at issue.

Fourth. In basing the award on the savings, gains or profits realized by the appellant, instead of upon the royalty charged by licensees, appellee never having exercised his right as a worker of this alleged invention.

Fifth. In allowing interest on the award.

It is in evidence that during the whole time for which the infringment is charged appellant worked under the Wright and Fouché patent of 1859, of which he is the assignee.

The Master reported that "no gains or profits have been proven to have been received or accrued to the defendant from the manufacture, use or sale of the improvement patented."
(Record p. 408.)

On the accounting before the Master, the burden of proof is on the complainant.

He has the privilege of examining the respondent and make him produce his books; but, to the extent to which his invention has been used, he must prove how much more economical or profitable it is than other known modes, which could have been used instead. No such evidence was put in before the Master, on the part of the complainant.

He proved the quantity of fat which had been treated by appellant during the period of alleged infringement. That, if he had treated that quantity of fat by the old saponifying process, he would have used so much sulphuric acid and lime, which year by year sold at such prices.

But no evidence was put in to prove the relative cost of manufacturing fat acids by the means described in the patent at issue and by the old processes free to be used.

The question is between what can be done by following the description in the patent, as compared with what was free to be used, and, as there was no such evidence put in, the Master could make no other report than he did.

The Court below, in making the award, must have gone upon the assumption, that as the Court had decreed that the use of water, heat and pressure by the respondent was an infringment of the patent at issue, and before that he had used sulphuric acid and lime in the old saponifying process, that must be the measure of savings, without proof as to the relative cost of working the two processes; one boiling in an an open tub at a temperature of 212° F.

and the other at a higher temperature in costly apparatus, an assumption based upon another assumption, that the construction of apparatus, and the use of fuel does not cost anything, and that lime and sulphuric acid are the only things which involve expense.

There was no evidence put in before the Master, on the part of complainant, to prove what proportion of the saving in sulphuric acid and lime, was due to the use of hot water by the Wright and Fouché mode of operation, and what to the use of hot water by the process described in the patent at issue.

On the part of the appellant, it was proved, before the Master, not only that by the means described in the patent at issue, the process could not be practically worked, but that he had utterly failed to make it work.

See testimony of
J. B. Moinier, Record, pp. 293 to 301.
C. T. Jones, " " 324.
Geo. Shillito, " " 331.
Michael Werks, " " 335.
Charles H. Grant, " " 361.
Florence Verdin, " " 142, 225, 340.
Roland G. Mitchell, appellee, Record, p. 351.

The above-named witnesses testified, that without the circulation of the water through the fat, which is the mode of operation invented by Wright and Fouché, and first presented in the patent under which appellant justifies, fat acids and glycerine cannot be manufactured by water, heat and pressure in competition with the old and previously well-known processes.

In view of this evidence, if appellant has manufactured fat acids and glycerine at less cost, and produced them of a better quality and with less waste, such savings and advantages are due to the use of the Wright and Fouché invention, and not to the use of the process claimed in the patent at issue.

Albert L. Mowry *v.* Asa Whitney, 14 Wallace, 620.

On the assumption of the validity of the patent and the infringement, evidence, such as was presented to the Master, and found in the record, at law would justify a verdict only for nominal damages, and in equity, if anything, an injunction only.

It is in evidence, and not denied, that appellee has never been in the business of manufacturing fat acids and glycerine, either by his patented process or any other, and that the only way in which he has attempted to realize from his patent has been by the grant of licenses, at twenty cents per hundred pounds of fat treated, and when the licensees used lime to facilitate the decomposition, less than twenty cents, in proportion to the per centage of lime used.

This was in evidence before the Court below, and it is respectfully submitted that if the appellee was entitled to any recovery, the Court should have limited the recovery to the royalty charged by appellee to his licensees.

Again, it is in evidence that—Seymour *vs.* McCormick, 16 How., 480—the circulation of the water through the fat, even if it be not indispensable to the practical use of water, heat and pressure, aids the decomposition, as the use of some lime does, and as the royalty charged by appellee to his licensees is reduced below twenty cents to the hundred pounds of fat, in proportion to the per centage of lime used in like manner, a reduction from twenty cents royalty should have been made in favor of appellant.

For the reasons given, the decrees of the Court below should be reversed, and the bill dismissed with costs.

Chas. M. Keller
Wm. M. Evarts
J. Cornell

Exhibit "A," referred to in defendants Brief-

CIRCUIT COURT OF THE UNITED STATES,

SOUTH. DIST. OF NEW YORK.

R. A. TILGHMAN
vs.
R. G. MITCHELL. } *Complainant's Evidence.*

EXHIBIT "PRICE'S PATENT CANDLE COMPANY'S LICENSE,"

Dated December 13, 1855.

Offered in evidence by Complainant, May 14, 1864.
See Record, No. 87. Marginal page 109; printed page 76–7.

This Indenture made the thirteenth day of December, one thousand eight hundred and fifty-five, between Price's Patent Candle Company, incorporated by "Price's Patent Candle Company's Act 1855," of the one part, and Richard Albert Tilghman of Philadelphia, in the United States of America, chemist, at present residing in London, of the other part. Whereas by Letters Patent under the Great Seal of the United Kingdom of Great Britain and Ireland, bearing date on or about the ninth day of January, one thousand eight hundred and fifty-four, in the seventeenth year of the reign of Her present Majesty Queen Victoria, No. 47, Her said Majesty granted unto the said Richard Albert Tilghman, his executors, administrators and assigns, the exclusive privilege of making, using, exercising and vending his invention of "Improvements in treating fatty and oily matters, chiefly applicable to the manufacture of Soap, Candles and Glycerine," within the said United Kingdom, the Channel Islands, and Isle of Man, during the term of fourteen years from the day of the date of the said Letters Patent, a Specification of which said Invention has been duly filed in the Great Seal Patent Office. And whereas by other Letters Patent under the said Great Seal, bearing date on or about the second day of August, one thousand eight hundred and fifty-five, in the nineteenth year of the reign of Her said Majesty, No. 1752, Her said Majesty granted unto the said Richard Albert Tilghman, his executors, administrators and assigns, the exclusive privilege of making, using, exercising and vending his invention of "Improvements in the Manufacture of Candles" within the said United Kingdom, the Channel Islands, and Isle of Man, during the term of fourteen years from the day of the date of the last mentioned Letters Patent, a Specification of which last mentioned invention has not yet been filed in the Great Seal Patent Office. *And whereas*, by an Indenture bearing even date herewith,

Five Shillings.

Duplicate or Counterpart. Original duly stamped.

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and made between the said Richard Albert Tilghman of the one part and the said Company of the other part, the said Letters Patent and the privileges thereby granted have been assigned by the said Richard Albert Tilghman unto the said Company, their successors and assigns, upon the terms and subject to the provisions of an Indenture of even date therein referred to, and being this present Indenture. Now, therefore, this Indenture witnesseth, that it is hereby agreed between the said parties hereto, that if the said Company shall be requested in writing by the said Richard Albert Tilghman, his executors, administrators or assigns, within six calendar months before the respective periods fixed by the conditions of the said recited Letters Patent for the payment of future Stamp Duties thereon, and the said Letters Patent shall not, under the provisions herein contained, have become revested or subject to the obligation of being re-assigned to the
2 said Richard Albert Tilghman, his executors, administrators or assigns, before the particular duties or duty mentioned in such request shall become payable, it shall be compulsory on the said Company, and they hereby agree, on receipt of such request, as aforesaid, a sufficient and convenient time before the prescribed time of payment, to pay such duties or duty, and to cause the said Letters Patent respectively to be stamped therewith, and to be produced according to the exigency of the said Letters Patent respectively, in order that the same may be kept on foot. And this Indenture further witnesseth, that in consideration of the assignment made by the Indenture hereinbefore recited, and of the performance of the covenants on the part of the said Richard Albert Tilghman, hereinafter contained, the said Price's Patent Candle Company hereby covenant with the said Richard Albert Tilghman, his executors, administrators and assigns, that the said Company will pay to him, and them, or his or their agent, authorized in writing, an annuity of One Thousand Pounds Sterling, calculated from the ninth day of October, one thousand eight hundred and fifty-five, and continuing during the continuance of the Letters Patent first hereinbefore recited, or until sooner determined by notice duly given in the manner hereinafter provided, such annuity to be paid at the principal office in England, for the time being, of the said Company, half-yearly, on the ninth day of April, and the ninth day of October, in every year, together with a proportionate payment, on the last day of the period of the continuance of the said annuity as aforesaid, in respect of any ultimate fraction of half a year, subject, nevertheless, to the provisions hereinafter contained; that is to say, Provided always, and it is hereby further agreed between the said parties hereto, that the said annuity shall cease to be payable, if and when the said first recited Letters Patent shall be actually repealed, without the act or connivance of the said
3 Company. And it is further agreed between the said parties hereto, that the said Company, their successors or assigns, may at any time during the continuance of the said annuity, cause the same to cease by notice, as follows: Such notice shall be in writing, and shall not require the common seal of the said Company, but may be sufficiently authenticated by the signature of the Secretary, or any director for the time being, of the said Company; such notice may be given at any period of any year, and shall fix a time for the termi-

nation of the said annuity, which shall not be earlier than two years from the delivery of the said notice; such notice shall be considered as sufficiently delivered, if the same shall be delivered to or left at the usual or last known place of business, or abode, of any agent for the time being, authorized by the said Richard Albert Tilghman, his executors, administrators or assigns, to receive the said annuity, or if the same shall be delivered to or left at the usual or last known place of busines or abode, or put into the Post Office, addressed to the usual or last known place of business or abode in England or elsewhere, of the said Richard Albert Tilghman, his executors, administrators or assigns, or any or either of them. And if from any cause such notice cannot be delivered in any of the modes hereinbefore mentioned, the same shall be considered as sufficiently delivered if advertised in the *Times* newspaper, or any other daily morning paper circulating in London.

Two Shillings, Sixpence.

And it is agreed, that the said annuity shall absolutely and unconditionally cease and determine at the time fixed by such notice for the cesser thereof as aforesaid, not being sooner than two years after the delivery of the said notice in manner aforesaid, Provided always, and it is

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further agreed between the said parties hereto, that upon the expiration of such notice and the consequent cesser of the said annuity as aforesaid, the assignment made by the hereinbefore recited Indenture, of the several Letters Patent hereinbefore recited, shall become and be void for all prospective purposes, but without prejudice to any claim or demand accrued before the avoidance thereof, or to any remedy which would have been available in respect of any such claim or demand if no such avoidance had taken place, and it shall be compulsory on the said Company, at the request and expense of the said Richard Albert Tilghman, his executors, administrators or assigns, to re-assign to him and them the said recited Letters Patent and any Letters Patent obtained in prolongation thereof, and the said Company hereby covenant with the said Richard Albert Tilghman, his executors, administrators and assigns, so to re-assign the same; Provided also, and it is hereby expressly agreed between the said parties hereto, that if the said annuity shall be determined in manner aforesaid, the said Company shall, after the determination thereof, and re-assignment of the said Letters Patent, if required in manner aforesaid, be wholly relieved from all special obligation hereby imposed upon them, to recognize the subsistence or validity of the said Letters Patent, and shall not be thereafter subject to any implied or other admission in relation thereto, or to any disadvantage in any proceedings at law or in equity, or otherwise by reason of the previous subsistence of the arrangements hereby made between the said parties hereto, but shall be to all intents and purposes whatsoever, remitted to the position in which the said Company stood in relation to the premises before the execution of these presents. And this Indenture further witness-

5

eth, that in consideration of the covenant hereinbefore contained on the part of the said Company for payment of the said annuity the said Richard Albert Tilghman, doth, for himself, his heirs executors and administrators, further covenant with the said Company, at the request and expense of the said Company, to use his and their best en-

deavors to obtain Letters Patent for the said United Kingdom, in respect to inventions of the said Richard Albert Tilghman, for which provisional protection has already been obtained or applied for by him, under the titles of Improvements in the manufacture of Candles, and Improvements in Treating fatty and oily bodies, and will at the like request and expense assign such Letters Patent, when obtained, to the said Company, and at the like request and expense, prepare and file the Specifications which will be required by the said Letters Patent, through the advisors of the said Company, but without responsibility as to the validity of such Letters Patent or Specifications. And it is agreed that such assignment shall be similar in form to the assignment hereinbefore recited, and shall become void for all prospective purposes, in the event of the assignment hereinbefore recited so becoming void, and also, that in the event of such avoidance the said Company shall be bound to re-assign the last mentioned Letters Patent, if any re-assignment thereof be required, in the same manner as if the provision hereinbefore contained, relative to the re-assignment of the Letters Patent, firstly and secondly above recited, were here
7 again inserted *mutatis mutandis*, in relation to the said Letters Patent to be hereafter assigned, as aforesaid. And further, that if the said Richard Albert Tilghman hath already made, or shall hereafter, during the continuance of the said annuity, make any invention in any manner applicable to any part of the business of said Company in manufacturing candles, night lights, oils, greases and soaps, and preparing or producing materials for such manufacture from any fatty, oily, greasy, bituminous, resinous or other animal, vegetable or mineral matters, and combining and applying materials for such manufacture, obtained from any such matters, the said Richard Albert Tilghman shall forthwith completely disclose such invention, and everything relating thereto, to the Directors, for the time being, of the said Company, to the intent that arrangements may be made between the said parties, for the acquisition of such invention by the said Company, upon terms to be arranged by agreement between the said parties. Provided always, and it is hereby declared, that the covenant lastly hereinbefore contained, shall not be understood to extend to inventions of improvements in the manufacture of sulphuric acid, alkalies, chorine, or other chemical agents, applied in the treatment of the fatty, oily, or other materials of candles, night lights, oils, greases or soaps, and that the said Richard Albert Tilghman will not, without the consent of the said Company, directly or indirectly, during the continuance of the said annuity, disclose any such invention, or any part thereof, to any person whomsoever, except the Directors of the said Company, nor himself use the same, or any part thereof, to the intent that every such invention may, during the continuance of the said annuity, be effectually kept secret from all persons whomsoever, except the Directors of the said Company. And the said Price's Patent
8 Candle Company hereby covenant with the said Richard Albert Tilghman, that no invention which shall be disclosed by him to the Directors of the said Company, as aforesaid, nor any part thereof, shall, without his consent, be used or directly or indirectly disclosed by the said Company, or any Director thereof. And it is hereby mutually agreed between the parties hereto, that save under

and in pursuance of arrangements to be hereinafter made between the said parties, in relation to such inventions as shall be disclosed by the said Richard Albert Tilghman to the Directors of the said Company as aforesaid, such respective inventions shall, during the continuance of the said annuity, remain wholly unused and undisclosed by either party, except as regards such disclosure to the Directors, as aforesaid, to the intent that no invention made by the said Richard Albert Tilghman, shall, during the continuance of the said annuity, be in any manner brought into competition in the United Kingdom, with the business of the said Company.

Two Shillings, Sixpence.

Provided always, that notwithstanding anything hereinbefore contained, the said Richard Albert Tilghman may, in every or any case, if he shall think fit, and without any obligation of first disclosing any such invention, as aforesaid, to the Directors of the Company, apply for and use his best endeavors to obtain, at his own expense, and with the utmost practicable expedition, Letters Patent for the United Kingdom for any such invention, upon condition and subject to the obligation that a Specification of the said invention shall, at the like expense, be filed in due time and manner, and with all practicable care and diligence, as regards the preparation thereof, and that the invention comprised in such Letters Patent and everything relating to such invention, shall, before or immediately after the sealing of such Letters Patent, be
9 disclosed to the Directors, for the time being, of the said Company, and that neither the privileges nor the invention comprised in such Letters Patent so obtained, shall, within the United Kingdom, be used at all by the said Richard Albert Tilghman, his executors, administrators or assigns, or any of them, or by any other or others acting with his, their, or any of their license, authority, consent or permission, until after the making of, nor afterwards, otherwise than in accordance with arrangements to be made by mutual agreement between the said Richard Albert Tilghman, his executors, administrators or assigns, and the said Company in relation to such Letters Patent and to the working of such invention. And it is further agreed and declared, that in the event of any wilful breach by the said Richard Albert Tilghman of his covenants hereinbefore contained, respecting future or additional inventions, or either of such covenants, the damages occasioned by such breach to the said Company shall be ascertained by arbitration in the manner hereinafter provided, and that such damages, together with all costs awarded to the said Company in any arbitration, or otherwise, recovered by the said Company, shall and may be set off against any payments of the said annuity subsequent to the commission of such breach. And it is hereby lastly agreed between the said parties hereto, as follows: All questions hereinbefore specifically referred to arbitration, and all other questions or differences of opinion which may arise upon a construction of these presents or the carrying into effect of the arrange-
10 ments hereby entered into, or any act, default or matter arising under or in relation to these presents, shall and may be referred to arbitration by either of the parties hereto, who shall give notice in writing to the other party of the matter intended to be referred, and also appoint an arbitrator on their part and if the other party shall

deavors to obtain Letters Patent for the said United Kingdom, in respect to inventions of the said Richard Albert Tilghman, for which provisional protection has already been obtained or applied for by him, under the titles of Improvements in the manufacture of Candles, and Improvements in Treating fatty and oily bodies, and will at the like request and expense assign such Letters Patent, when obtained, to the said Company, and at the like request and expense, prepare and file the Specifications which will be required by the said Letters Patent, through the advisors of the said Company, but without responsibility as to the validity of such Letters Patent or Specifications. And it is agreed that such assignment shall be similar in form to the assignment hereinbefore recited, and shall become void for all prospective purposes, in the event of the assignment hereinbefore recited so becoming void, and also, that in the event of such avoidance the said Company shall be bound to re-assign the last mentioned Letters Patent, if any re-assignment thereof be required, in the same manner as if the provision hereinbefore contained, relative to the re-assignment of the Letters Patent, firstly and secondly above recited, were here
7 again inserted *mutatis mutandis*, in relation to the said Letters Patent to be hereafter assigned, as aforesaid. And further, that if the said Richard Albert Tilghman hath already made, or shall hereafter, during the continuance of the said annuity, make any invention in any manner applicable to any part of the business of said Company in manufacturing candles, night lights, oils, greases and soaps, and preparing or producing materials for such manufacture from any fatty, oily, greasy, bituminous, resinous or other animal, vegetable or mineral matters, and combining and applying materials for such manufacture, obtained from any such matters, the said Richard Albert Tilghman shall forthwith completely disclose such invention, and everything relating thereto, to the Directors, for the time being, of the said Company, to the intent that arrangements may be made between the said parties, for the acquisition of such invention by the said Company, upon terms to be arranged by agreement between the said parties. Provided always, and it is hereby declared, that the covenant lastly hereinbefore contained, shall not be understood to extend to inventions of improvements in the manufacture of sulphuric acid, alkalies, chorine, or other chemical agents, applied in the treatment of the fatty, oily, or other materials of candles, night lights, oils, greases or soaps, and that the said Richard Albert Tilghman will not, without the consent of the said Company, directly or indirectly, during the continuance of the said annuity, disclose any such invention, or any part thereof, to any person whomsoever, except the Directors of the said Company, nor himself use the same, or any part thereof, to the intent that every such invention may, during the continuance of the said annuity, be effectually kept secret from all persons whomsoever, except the Directors of the said Company. And the said Price's Patent
8 Candle Company hereby covenant with the said Richard Albert Tilghman, that no invention which shall be disclosed by him to the Directors of the said Company, as aforesaid, nor any part thereof, shall, without his consent, be used or directly or indirectly disclosed by the said Company, or any Director thereof. And it is hereby mutually agreed between the parties hereto, that save under

and in pursuance of arrangements to be hereinafter made between the said parties, in relation to such inventions as shall be disclosed by the said Richard Albert Tilghman to the Directors of the said Company as aforesaid, such respective inventions shall, during the continuance of the said annuity, remain wholly unused and undisclosed by either party, except as regards such disclosure to the Directors, as aforesaid, to the intent that no invention made by the said Richard Albert Tilghman, shall, during the continuance of the said annuity, be in any manner brought into competition in the United Kingdom, with the business of the said Company.

Two Shillings, Sixpence.

Provided always, that notwithstanding anything hereinbefore contained, the said Richard Albert Tilghman may, in every or any case, if he shall think fit, and without any obligation of first disclosing any such invention, as aforesaid, to the Directors of the Company, apply for and use his best endeavors to obtain, at his own expense, and with the utmost practicable expedition, Letters Patent for the United Kingdom for any such invention, upon condition and subject to the obligation that a Specification of the said invention shall, at the like expense, be filed in due time and manner, and with all practicable care and diligence, as regards the preparation thereof, and that the invention comprised in such Letters Patent and everything relating to such invention, shall, before or immediately after the sealing of such Letters Patent, be disclosed to the Directors, for the time being, of the said Company, and that neither the privileges nor the invention comprised in such Letters Patent so obtained, shall, within the United Kingdom, be used at all by the said Richard Albert Tilghman, his executors, administrators or assigns, or any of them, or by any other or others acting with his, their, or any of their license, authority, consent or permission, until after the making of, nor afterwards, otherwise than in accordance with arrangements to be made by mutual agreement between the said Richard Albert Tilghman, his executors, administrators or assigns, and the said Company in relation to such Letters Patent and to the working of such invention. And it is further agreed and declared, that in the event of any wilful breach by the said Richard Albert Tilghman of his covenants hereinbefore contained, respecting future or additional inventions, or either of such covenants, the damages occasioned by such breach to the said Company shall be ascertained by arbitration in the manner hereinafter provided, and that such damages, together with all costs awarded to the said Company in any arbitration, or otherwise, recovered by the said Company, shall and may be set off against any payments of the said annuity subsequent to the commission of such breach. And it is hereby lastly agreed between the said parties hereto, as follows: All questions hereinbefore specifically referred to arbitration, and all other questions or differences of opinion which may arise upon a construction of these presents or the carrying into effect of the arrangements hereby entered into, or any act, default or matter arising under or in relation to these presents, shall and may be referred to arbitration by either of the parties hereto, who shall give notice in writing to the other party of the matter intended to be referred, and also appoint an arbitrator on their part and if the other party shall

not, within three calendar months after written notice of such appointment, appoint an arbitrator on their part, such first mentioned arbitrator shall proceed alone to determine the matter referred, and in the event of the said other party appointing an arbitrator on their part, the two arbitrators shall, before proceeding in the reference, appoint a third person either to act as a third arbitrator together with them throughout the proceedings, or to act as umpire in case of their disagreeing, as such two first-named arbitrators shall determine at the time of the appointment of such third arbitrator or umpire, or in case of the non-appointment of such third arbitrator or umpire by the two arbitrators first-named within ten days after both such two arbitrators shall have been themselves appointed, the third arbitrator or umpire shall and may be appointed by Her Majesty's Attorney or Solicitor-General for the time being; and if there shall be three arbitrators, all matters relating to the reference shall be determined by a ma-
11 jority of them, and the award of such arbitrator or arbitrators, or of two of such arbitrators, or of two of such arbitrators and umpire, as aforesaid, as the case may be, shall be binding and conclusive on both parties in difference, and shall be submitted to and performed by them and each of them, and such award shall be made in writing, ready to be delivered to the said parties, or one of them, within a time to be fixed by the said arbitrator, or arbitrators, or umpire, before entering on the reference, or such further time as he or they shall from time to time, before the expiration thereof, fix in like manner, and such arbitrator or arbitrators, or umpire, shall be at liberty to examine all or any parties or witnesses on oath, and the said parties hereto, their successors and assigns, shall produce before him or them, or as he or they may require, all or any books, deeds, papers, and writings in their or either of their custody or power, touching the matters in difference, and neither party shall proceed at law or in equity against the other party or against the arbitrators or umpire, or any of them, except for the purpose of enforcing the award, and the submission herein contained may be made by either party a rule of Her Majesty's Court of Queen's Bench at Westminster. And it is agreed that every arbitration under these presents shall be entirely conducted in England, and that no person shall be appointed an arbitrator or umpire who shall not be resident in England, and that every
12 requisition, notice or other document requiring service upon either party in relation to any arbitration may be delivered at or put into the Post Office in the United States or in England, addressed to the principal place of business, for the time being, of the said Company, if the said Company is to be affected thereby, or delivered at or put into the Post Office addressed to the usual or last known place of abode or business, in England or elsewhere, of the said Richard Albert Tilghman, his executors, administrators or assigns, or any of them, or any agent for the time being authorized by him or them in relation to the receipt of the said annuity, or otherwise in relation to the premises; and that as regards all documents sent by post, all periods of time connected therewith shall be understood to run from the time of putting the same into the Post-Office.

In witness whereof the said Richard Albert Tilghman has hereunto

set his hand and seal, and the said Company have hereunto affixed their common seal, the day and year first above written.

R. A. [SEAL] TILGHMAN.

PRICE'S PATENT CANDLE COMPANY. Incorporated by Act of Parliament.

Signed, sealed and delivered by the within-named Richard Albert Tilghman, in the presence of
THOS. COUSINS, JR., Clerk to Messrs. WILSON & BRISTOW, Solicitors, 1 Copthall Buildings, London.

13

[Endorsed.]

Dated 13th December, 1855.

PRICE'S PATENT CANDLE COMPANY,
and
R. A. TILGHMAN, Esq.
Duplicate.
Deed of Arrangement respecting Letters Patent.

Marked:
Exhibit Price's Patent Candle Company's License.
K. G. W.,
Examiner.

Supreme Court of the United States.

Nos. 87 and 340.

ROLAND G. MITCHELL, Appellant,

vs.

RICHARD A. TILGHMAN, Appellee.

THE SAME vs. THE SAME.

APPELLANT'S BRIEF.

C. M. KELLER,
WM. M. EVARTS,
Of Counsel for Appellant.

MGILL & WITHEROW, PRINTERS, WASHINGTON, D. C.

Supreme Court of the United States.

ROLAND G. MITCHELL, Appellant,
vs.
RICHARD A. TILGHMAN, Appellee,
No. 87.

RICHARD A. TILGHMAN,
vs.
ROLAND G. MITCHELL.
No. 340.

APPELLANT'S BRIEF.

STATEMENT AND HISTORY OF THE LITIGATION IN THE CIRCUIT COURTS OF THE UNITED STATES UNDER THE PATENT IN ISSUE IN SUCH SUITS, AND OF THE CONNECTION OF SUCH LITIGATION WITH THE TWO SUITS NOW BEFORE THIS COURT.

These are suits brought in the court below for alleged infringements of certain Letters Patent granted to Richard A. Tilghman, the appellee, October 3, 1854, antedated January 9, 1854, for "Improvement in Processes for Purifying Fatty Bodies," and which patent was extended on the 23d of November, 1867, for the term of seven years, from January 9, 1868.

Suit No. 87 is an appeal from a decree rendered in a suit brought in the Circuit Court of the United States for the Southern District of New York, by the appellee against appellant for an alleged infringement of the original letters patent, and which decree was in favor of the complainant

below, sustaining the patent, and finding an infringement thereof; and

Suit No. 340 is a similar appeal from a decree rendered in the same court, in a suit brought by the same complainant (the appellee in this court) against the same defendant (the appellant), for an alleged infringement of the patent, and which decree was, as in the former case, in favor of the patentee.

A short historical sketch of *all* the litigation under the said Tilghman patent will, it is respectfully submitted, materially assist in properly understanding the present cases, Nos. 87 and 340.

The first suit brought under such patent was that of—

Richard A. Tilghman,
vs.
Michael Werk. } No. 1.

which was brought in the Circuit Court of the United States for the Southern District of Ohio, in 1860, and the decision therein was rendered in 1862, by Judge Leavitt.

In this suit, the testimony before the court was comparatively meagre and imperfect, no evidence being put in on the part of the defendant in reference to the "Scharling" process, published in 1850, or as to the "Perkins Engine Papers," published in 1823, or as to "Daniel's Water Barometer," published in 1832, or as to the "Radley & Myers" patent (1850), or as to extended trials and efforts made by the patentee, Tilghman, in France, in 1854–5, and again in 1858, to practically work his invention, and which experiments clearly proved his invention wholly impracticable.

The learned judge, upon the evidence before him, sustained the patent, but qualified his decision by saying:

"Yet it is perhaps questionable whether it" (the patentee's process) "can be successfully adopted by the manufacturer."

The next suit brought under such patent was that of—

Richard A. Tilghman,
vs.
Roland G. Mitchell. } No. 2.

which was brought in the Circuit Court for the Southern District of New York, in 1860, and which is the same suit now before this court on appeal, and designated on the calender as No. 87.

In this suit, also, no evidence was put in on the part of the defendant in his proofs for final hearing, either as to the "Perkins Engine," "Daniel's Water Barometer," or as to unsuccessful trials and efforts of the patentee in 1854–5, and repeated in 1858, in France, and which is referred to as the Moinier Evidence, and for the reason that such evidence could not be found and obtained in time for such hearing.

A decision in such case was rendered by Mr. Justice Nelson in 1864, and which was in favor of the patentee; but such decision of that judge was probably based, in part at least, upon the prior decision of Judge Leavitt, above referred to, and rendered in 1862.

In respect to this decision of Mr. Justice Nelson, it is respectfully submitted, that the learned judge was misled as to an important fact in respect to the practical working and operation of the Tilghman process, as described in his patent, by certain chemical experts, and that if he had not been so misled his decision would have been of a different purport.

After the decree in such case a reference was taken to a master, to take evidence and report as to the profits realized by the defendant, and on such reference there was put in the "Moinier" Evidence as to the efforts of the patentee to put his invention practically into use on an extended scale, and his utter failure in such attempt, and also evidence as to the "Perkins' Engine" and the "Daniel's Water Barometer," and also the *Emery* Letter, so-called, written by the patentee in 1856, and giving his own views as to his patent, a copy of which letter is as follows:

41 SOUTHAMPTON PLACE, EUSTON SQUARE,
LONDON, *June* 25, 1856.

THOS. EMERY & SON, *Cincinnati.*

GENTLEMEN: I have received from Mr. Davenport your favor of 30th of May last. Our experiments in the factotories here and in Paris have shown that on a large scale the decomposition of fats by water is more conveniently effected by modifying the apparatus originally proposed, so that the fat and water are exposed to a comparatively lower heat and pressure for a longer time, instead of a very high pressure for a few minutes; and a considerable quantity of material is treated at one charge in an ordinary steam-boiler lined, with lead or copper, and provided with an agitator, in the place of using the continuously-working pumps and coil of pipes. At a pressure of 225 pounds per inch, tallow or palm-oil, or lard stearine is completely decomposed in five hours. In the course of a few months we shall probably have going on at Price & Co.'s works an apparatus on the above plan, capable of treating several tons per day. Until my process is in actual use in England I have decided not to begin its introduction into the United States, and therefore cannot at present reply to your request as to terms of sale. As soon as it is well-established here I intend returning home, and will immediately communicate with you. I give below answers to such of your questions as I have materials for, and remain,

Very respectfully, yours,

R. A. TILGHMAN.

Answers to Questions.

1. The process is not practically at work on the large scale, but Price & Co., of London, and the Companie Generale de Stearinerie, Moinier & Co., La Villette, Paris, are engaged in experiments preparatory to starting it.

2. The process is applicable to all sorts of fats and oils, vegetable or animal, hard or soft.

3. There is no other waste than the dirt and glycerine.

4. From 100 pounds clean, dry tallow we obtain 97½ pounds fat acids, and eight pounds concentrated glycerine.

5. The color of the product depends upon that of the original material. Palm-oil product is of a light gray color. Tallow and stearine are somewhat whiter than the same material would produce by lime saponification.

6. In this respect the product resembles that from lime saponification of the same materials.

7. Yes; hot and cold pressing—just like saponified stuff.

8. Hydraulic presses are used. The product is more crystalline, and presses better than saponified stuff.

9. The danger is no greater than in working ordinary steam-boilers.

10. Answered in No. 9.

11. The apparatus is of ordinary boiler and coppersmith work, and the cost can be calculated by any one in those trades.

12. There is no more wear than in the ordinary lead or copper-lined tubes.

13. A boiler forty feet long by thirty-two inches diameter, at 225 pounds per inch, would decompose 4,500 pounds in six hours.

13. Tallow and good stearine give, by pressing, a perfectly white product. Palm oil or dark fat would require to be distilled after going through the apparatus.

14. For good white material, like tallow, or good lard stearine, the lime-saponification process is the best. For cheap dark stuff, like palm-oil, grease, lard, stearine, &c., the sulphuric distillation is preferable. In France they generally use both processes in the same factory. Saponification for white, distillation for dark material. To distill white fats would not be economical, as the waste by tar, &c., would more than balance the saving by acid.

16.

17. The same product as from perfectly decomposed saponified stuff.

18. There is no offensive smell.

19.

After the testimony had been closed in such reference, the master reported that—

"No gains or profits had been proven to have been received by, or to have arisen or accrued to, the defendant from the manufacture, use, or sale of the improvements patented in the letters patent set forth and described in the order of reference."

To this report the complainant below excepted, and, upon argument of such exception, his honor Judge Blatchford overruled the decision of the master, and decreed

that the defendant, the appellant in this court, was chargeable—

As profits, with the sum of	$160,699 05
And with interest thereon, in the sum of	69,127 58
And for costs	954 98
Making together the sum of	$230,781 61

This opinion of Judge Blatchford was delivered August 26, 1871.

Previous to the delivery of such decision by Judge Blatchford the patent referred to had been extended, to wit: in November, 1867, for the term of seven years, from January 9, 1868.

Under such extended patent, and in 1868, two suits, entitled, respectively,

Richard A. Tilghman *vs.* Michael Werk, Thomas Kirby, and M. Schwartz. } No. 3.

and

Richard A. Tilghman *vs.* George Shillito. } No. 4.

were brought in the Circuit Court of the United States for the Southern District of Ohio.

These suits were progressed *pari passu*, and were heard together, upon the same evidence.

In these suits the testimony put in, in the New York suits—Tilghman *vs.* Mitchell—on the reference before the master, was, by stipulation, made a part of the testimony to be considered by the court in determining the proper scope and extent of the actual invention of the patentee.

These suits were heard before his honor Judge Emmons in May, 1870, and decided by him in the November following, directing a decree in favor of the complainant, but refusing an injunction, and permitting the defendant to give security.

Judge Emmons' decision was based upon the decisions of Judges Leavitt and Nelson, by which he regarded him-

self as bound and to be governed, and is not an expression of his own opinion upon the merits of the cases as shown by the evidence therein; indeed, he expressly declares that, except for such former decisions, he should give a different construction to the patent than had before been given to it.

In his decision the learned judge says:

"Although the record in this case, in reference to some views which a superior court may possibly take, contains some material additional proofs," * * * "after much consideration, I am confident, that without a violation of judicial propriety and the best interests of all who pursue or defend here, the cases already decided—that of Tilghman *v.* Werk, and Tilghman *v.* Mitchell—between these same parties, must be followed."

Again:

"Were I to consider this matter uninfluenced by precedent, I should require some additional investigation and argument before rejecting this view"—that the claim of the patent includes only those higher degrees of heat at which lead and other substances mentioned in the patent will melt—"I am by no means certain that it cannot be sustained."

And again:

"I thus briefly advert to the leading objections of the defense (by no means going over all) solely to show that they are disposed of by the previous cases, and not to discuss them upon principle. I repeat, were I at liberty thus to treat the whole case, *I fear I should be compelled to give the patent a more limited construction than it has received.*"

Subsequently to the bringing of the two last-mentioned suits, another suit,

Richard A. Tilghman
v.
Roland G. Mitchell,
} No. 5.

was brought by the patentee (the appellee here) against the appellant, Mitchell, in the Circuit Court of the United States for the Southern District of New York, under the extended patent, which has also been brought to this court on appeal, and is the same suit on the present docket, numbered 340.

In this suit, by stipulation, the testimony put in by the

respective parties in the several previous suits of Tilghman *v.* Werk, Tilghman *v.* Mitchell, Tilghman *v.* Werk, Kirby & Swartz, and Tilghman *v.* Shillito, was made evidence therein, and some additional testimony also introduced.

This suit being before the same court and judge, in which and by whom a decree had previously been rendered in favor of the patent, a like decree as in the former case between the same parties was entered therein in favor of the patentee, and the court fixed the profits upon the same basis of computation which had been adopted in the former suits.

The decree entered found that the defendant was chargeable, under the extended patent, with profits

In the sum of	$91,387 30
And with interest thereon	14,982 94
And for costs	53 20
Amounting in all to the sum of	$106,423 45

It is submitted, therefore, that there has not been thus far any judicial interpretation of the plaintiff's patent, except upon incomplete evidence, and that in no suit except in cause No. 340 have the proofs embraced all the evidence bearing upon the patent and necessary to a full understanding thereof.

REFERENCE TO EVIDENCE IN THE RECORD OF CASE NO. 340 NOT FOUND IN RECORD NO. 87, SUBMITTED FOR CONSIDERATION IN CONNECTION WITH THE EVIDENCE NOTED UNDER THE SEVERAL POINTS IN THE BRIEF SUBMITTED IN THE CASE NO. 87.

As to the description of the process and apparatus used by appellant, and the mode of operation, on pages 6 and 7 of brief, see testimony of E. S. Renwick. (Record No. 340, pp. 564, 565.)

As to chemical constitution of water, on page 8 of brief, see testimony of Prof. Chandler. (Record No. 340; Int. 4 to 7, p. 570.)

As to the chemical rationale of the decomposition of fats and of the union of the elements thereof with other substances to produce fat acids and glycyrine, on pages 8 and 9 of brief, see testimony of Prof. Chandler and E. S. Renwick. (Record No. 340, pp. 562, 563, 569.)

As to point 1, division (*a*) beginning on pages 16 and 17 of brief, see Tilghman's English patent. (Record No. 340, pp. 611–615.)

As to point 1, division (*b*) on pages 18 and 19 of brief, see testimony of E. S. Renwick. (Record No. 340, pp. 562, 563.)

As to point 1, division (*c*) on pages 19 and 20 of brief, see testimony of E. S. Renwick. (Record No. 340, pp. 562, 563.)

As to point 1, division (*c*) of brief, pages 20 and 21, (see testimony of E. S. Renwick. (Ints. 9 and 10, p. 564.)

As to point 11, division (*a*) of brief, pages 23–35, a letter was put in evidence on the part of appellee, dated London, June 25, 1856, and signed R. A. Tilghman, and addressed to Emery & Sons, Cincinnati. (Record No. 340, p. 352.)

What Tilghman says in this letter, and in another, in Record No. 87, p. 406, dated London, July 20, 1857, addressed to M. de Fontaine Moreau, is contradicted by his testimony, in which he admitted that he was in London from 1854 to some time in 1858; frequently visited some of the works of the Price Patent Candle Co., but had no knowledge whatever, either of the process which they used or of the temperatures at which they used them. (Record No. 87, p. 76.)

The statements in these letters are also contradicted by the testimony of J. B. Moinier, referred to in brief.

His honor Judge Blatchford erred in his conclusions as to the force of these letters, in his opinion that these tend to prove that the process of the Tilghman patent at issue was reduced to successful practice.

If these letters prove any thing, it is that after the grant of the patent of 1854 he found that the process could not be practically worked by the means described, but that in 1856 he was making experiments to try to find out some means which would answer.

The other letter is one addressed to Tilghman by J. P. Wilson, of the Price Patent Candle Company. (Record No. 340, p. 353.)

This letter is dated July 13, 1865, eleven years after the grant of the patent at issue.

If this letter proves any thing, it is that that company at sometime had digesters with stirrers, which were insufficient to effect the required circulation, and that there was some proposition to make use of them in working the process introduced in 1863 in Jones' Works in Cincinnati, for producing the circulation by a pump.

In 1856, two years after the grant of the patent at issue, Tilghman obtained a patent in France, (Record No. 340, p. 619,) in which he shows conclusively, not only that at the time of the grant of the patent at issue, he had no idea of working this process at lower temperatures, but that various unsuccessful attempts had been made to effect the decomposition on a commercial scale; and he then describes some modifications, none of which, from the evidence, were reduced to practice, and certainly were not, up to the year 1858, as appears from the testimony of Moinier, before referred to; but some of which, such as introducing steam into the vessel containing the fat, and using a stirrer, was worked for a short time at Grant's, and abandoned by him as more costly than and inferior to the old and well-known processes.

As to point III—

The evidence in Record 340 is in a great part taken from the suits in Cincinnati.

It appears from this evidence that some, if not all, the defendants use lime and water in their process, but lime in less proportion than required for the old saponifying

process, and boiled at a higher heat than one atmosphere.

The chemical experts in the suit against Werk testified on the part of Tilghman, what may be true, that in such a case a part of the fat acids are produced by the water, and part by the lime, because the proportion of lime used is not sufficient to saturate all the fat acid.

The testimony of these experts will be found—

Prof. Booth, (Record No. 340, p. 52.)

Prof. Rogers, (Record No. 340, p. 69.)

Prof. Ghent, (Record No. 340, p. 79.)

It appears from this testimony that the heating of the fat and lime by introducing superheated steam, and using less lime than will saturate all the fat acids, is a use of the invention described in the Tilghman patent at issue.

But in the suit against appellant the same witnesses testified, that by the use of superheated steam the glycerine would be destroyed and changed to acroline; and that the French patent of 1825, granted to Guy Lussac and Chevreul, which states that by boiling at a higher temperature than one atmosphere, less alkali is required, does not show a want of novelty in the process described in the patent at issue.

As to Point IV—

As to the fact that the mode of operation of the process marked by appellant is substantially different from the mode of operation described in the patent at issue, see testimony of E. S. Renwick. (Record No. 340, Ints. 11 to the end, pp. 564 to 569.)

As to Point V, (Brief, p. 85)—

The rate of charge to licenses adopted by appellee, 20 cents per hundred pounds of fat treated by water alone or water with one half of one per cent. of lime, and 10 cents per hundred pounds of fat treated with seven per cent. of lime. This fact is stated by appellee in his sworn statement before Commissioner of Patents, on application for the extension of his patent. (Record No. 340, p. 386.)

AS TO THE RECOVERY ALLOWED TO THE COMPLAINANT, AS OF THE DEFENDANT'S PROFITS, WHICH SHOULD BE CREDITED TO HIS USE OF THE COMPLAINANT'S PATENT.

STATEMENT.

In suit No. 87, the prayer of the bill is, "that the defendant may be compelled to account for and pay over the *income* thus unlawfully derived from the violation of the rights of your orator." (Rec. fol. 3.)

Upon the accounting and proofs concerning defendant's "income" or profits from the infringement, the master reported that "no gains or profits have been proven to have been received or accrued to the defendant from the manufacture, use, or sale of the improvement patented." (Rec. fol. 682.)

Upon the complainant's exceptions to this report, the court, without referring the matter back for ascertainment of profits by the master, upon further directions as to their ascertainment, itself decreed the profits to be measured by the market value of the chemicals, lime and sulphuric acid, dispensed with by the defendant's process as compared with the old process of saponification by lime, *without any consideration of the increased expenses in other particulars* of the defendant's process.

The court also added the market value of the increased production of fat acids, (two pounds to the hundred treated,) and the market value of the entire production of glycerine.

The court computed these, in the aggregate, to amount to $160,699 05, and allowed interest upon annual rests to the further amount of $69,127 58. (Decree, following p. 416 of Record.)

In suit No. 340, without the intervention of a master, the court adopted the same rule or measure as to complainant's profits, and decreed in his favor for the value of lime and sulphuric acid saved, and of increased production of

fats and proceeds of glycerine sold, the sum of $91,387 30, and interest, upon annual rests, to the further amount of $14,982 94. (Decrees, fols. 1040, 1056.)

It appears in evidence that the complainant had never worked his patent as a manufacturer, but from the start had adopted the system of selling licenses at a rate of 20 cents for every hundred pounds of matter treated by the licensee, and had adhered to the same rate.

To manufacturers who continued to use lime in connection with complainant's process, the complainant charged for a license, only, at the rate of 10 cents per hundred pounds treated.

It appears by the complainant's application for a renewal of his patent, that the proportion of *economic gains in manufacture*, which would be effected by the use of this patent, which should be credited as royalty or license fee to the patentee, was about *one tenth part* of such economic gains, and that the said rates of 20 cents and 10 cents respectively amounted to that proportion. (Record, fols. 972, 975.)

By the final decree the defendant was not subjected to injunction against using his process, *so long as he paid the complainant said rates of license fee*, to wit, twenty cents per hundred pounds of matter treated. (Record, fol. 1040.)

Points.

I. A patentee, having occasion to seek redress and reparation for supposed infringement of his patent, has open to him two courses, at his election—

(*a*) He may sue at law for damages, and, under the instructions of the court, the jury will award him a reasonable measure of indemnity for the injury he has suffered.

In this remedy the question of what, or whether any, *profits* have been made by the defendant is no necessary part of the inquiry.

(*b*) Or the patentee may proceed in equity for an account of the *profits*, which the defendan thas actually realized in

the course of the infringement, which are fairly to be ascribed to the complainant's patent as a contributory agent in the earnings.

The theory of this mode of redress is to make the defendant an agent or trustee of the use of the patent, and, so, accountable to the patentee for its earnings in the business.

If the use of the patent has produced no earnings or profits to the infringer, *this* method of redress will produce nothing to the patentee.

But in this there is no hardship, for his remedy for damages is still open to him.

So, too, the use of the patent by the infringer gives to the patentee, under this method of *equitable accountability*, no recovery beyond the share of the manufacturer's profits which is assignable to the use of the patent in question, considered as a co-operating agency in producing the profits. Whatever is assignable to the use of other patents, or to the capital and labor and faculties of the manufacturer, as employed in the business, is not the earnings of the complainant's patent.

However difficult the ascertainment or apportionment may be, the end proposed, in this method of equitable accountability, is none other than to arrive at the amount of *profits realized by defendant as agent or trustee of the patentee in the use of the patent, and as the product of such use.*

In special cases, where neither this measure of equitable accountability nor recourse for actual damages may accomplish full justice between the parties, the statute has provided that the court may *treble* the damages. (Cowing *vs.* Rumsey, 4 Fisher, 276. Woodruff C. J.)

II. In these cases the patentee has sought, through the intervention of a court of equity, an account from the defendant of the profits he has made in his business of a manufacturer, that is fairly apportionable to the benefits of complainant's patent as used in that business, and no

other measure of relief can be accorded him on the pleading and proofs.

(*a*) Upon the proofs, the master's report that the defendant had made no profits by the use of the complainant's invention was correct.

The court below erred in allowing any recovery, notwithstanding such report.

This has been considered under Point V, p. 85 of the principal brief.

(*b*) But if the court found the master in error in his estimate of the working value of complainant's patent, the court should have referred the matter back for an ascertainment of profits, under instructions from the court.

The proofs, though adequate to show that *no* profits had accrued upon the master's view of the working value of the patent, and perhaps adequate to show that there were *some* profits upon the learned judge's view of the working value of the patent, yet were wholly incomplete to show *what* those profits were.

A further inquiry was absolutely necessary to sustain any recovery for the complainant.

III. But if the court proceeded to adjudge that the complainant was entitled to the full measure of recovery for the use of his patent that would flow from adequate proofs that it had been a contributing agency towards the profits of the defendant's manufacture, and should be accorded the measure of profit which belonged to its use in such business, then the court fell into manifest error in its computation of profits.

When the patentee has fixed a rate of license fees for the use of the patent, which is open to all manufacturers, and is paid by such as use his patent, the profit which the manufacturer makes by using the patent without license is manifestly the license fees which he has saved by such use.

Suffolk Co. *v.* Hayden, 3 Wall., 320.

This is necessarily so for several sufficient reasons:

(1) It is very plain that the manufacturer, by taking a license, could have used the patent, as he has done, with no greater cost or expense than the payment of such license fees.

(2) It is equally clear that as the competing manufacturers gain all the advantages of the patent at this rate, the manufacturer using the patent without paying this rate can make *thereby* out of the market nothing but the license fees saved.

The only burden upon the market, ascribable to the use of the patent, is the license fees. If all pay them, the profits they thereafter make are upon the usual manufacturing and commercial calculations. If one does not pay them, all that he makes out of the use of the patent is what advantage he has gained in the market over his competitors by saving the patent fees.

(3) But the patentee himself has fixed the share of productive manufacture, involving so many contributory agencies to its profits, which is to be ascribed to his patent.

He says, in effect, "my patent may be made useful in manufacturing industry by the aid of the resources of capital and commerce. By itself it will produce nothing to me or to the community. How large a part of the economic savings which my patent will accomplish the manufacturer can secure, or how much the community will gain, does not appear. But one tenth of these economized savings is the patent's fair share. The further profits, if made, belong to capital and commerce."

The court, therefore, should have computed the license fees upon the fats treated by the defendant, as the measure of the defendant's profit from the use of the patent.

IV. But if the measure of the rates of license is not necessarily the true measure of the defendant's accountability, the actual measure adopted by the court was clearly erroneous.

This measure is, to charge the defendant with the full

amount of *economical savings to the community*, as the equivalent, (1) of the profits made in the manufacturer's business, without any proof of what his real profits have been; and (2) to impute *all* these economical savings as the share of the patent right, without computing the appropriate proportion assignable to other elements—capital, industry, skill, expenditure, commercial activity and prudence—which furnish the essential energy, without whose participation in the earning of profits, the patent right would remain unfruitful both to the patentee and to the public.

The economical savings which a patent promises constitute, so to speak, the contribution which the patentee brings to the manufacturer's capital, skill, industry, and whole productive power, towards the commercial gains which all together may hope to earn.

When the *earnings* are ascertained, then the share of these earnings which belongs to the different contributory elements is to be computed, and what belongs to the patent, and that only, is to be accounted for to the patentee.

This scheme—*suum cuique tribuito*—has been wholly overlooked by the court, and the gross economical savings to the community have been carried into the pocket of the patentee from that of the manufacturer, without *any* evidence that any part of such savings had been realized in money by the manufacturer, or any allowance for what share thereof, if any profits were realized by him, belonged to him for his contribution to make the patent fruitful.

Thus the defendant has been treated as if he had obtained from the public the old prices of the discarded saponification process, and had thus enhanced the profits of that process by the expenditures for chemicals required by that process, which the new process has dispensed with.

And, thus—in face of the complainant's rate of license fees, fixed at *one tenth* of these savings, which, of course, reduced the cost of production and the market by the other nine tenths—the defendant is made to account for these other nine tenths which the public has gained, as if he, the defendant, had acquired them.

This is preposterous.

But, again, the defendant was entitled—

(1) To a comparison between the most favorable process in use not covered by the patent, and the complainant's process, and not to be adjudged by the standard of the old saponification process.

(2) The increased cost of the new apparatus, and other increased expenses of the complainant's process, were to be set off against the gains by dispensing with chemicals.

(3) The defendant should have been allowed the advantages which his own patent gave to the process by automatic circulation, which forms no part of the complainant's process.

The decrees, therefore, if sustained on the merits, must be reversed as to the amounts computed as profits, and the ascertainment of profits referred back to the master with proper instructions.

Mowry *v.* Whitney, 14 Wall., 620.
Crossley *v.* Derby G. L. Co., 3 Myln. & Cr., 428.

V. The learned judge erred, also, in the allowance of *interest* as a part of the profits.

This point has been expressly adjudged by this court in the case of *Mowry* v. *Whitney*, 14 Wall., 653.

VI. The defendant, in case the complainant's patent should be sustained and the infringement established, is entitled to a computation of profits in conformity with the propositions hereinbefore insisted upon.

C. M. Keller,
Wm. M. Evarts,
Of Counsel.

IN THE

U. S. SUPREME COURT.

No. 87.

ROLAND G. MITCHELL, Appellant,

vs.

R. A. TILGHMAN, Appellee.

No. 340.

SAME Appellant

vs.

SAME Appellee.

BRIEF and ARGUMENT for APPELLEE.

GEORGE HARDING, Counsel for Appellee.

PHILADELPHIA:
E. C. MARKLEY & SON, PRINTERS, 422 LIBRARY STREET.
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SUPREME COURT OF THE UNITED STATES.

ROLAND G. MITCHELL, *Appellant*, *vs.* RICHARD A. TILGHMAN, *Appellee.*	No. 87.
SAME APPELLANT, *vs.* SAME APPELLEE.	No. 340.

APPELLEE'S STATEMENT OF CASE.

These two cases are suits in equity, instituted under appellee's patent, for a process for making fat acid and glycerine from neutral fat; suit No. 87 having been brought during the first term of the patent, and suit No. 340 having been brought under the extended term of the same patent.

In both cases final decrees were given in favor of the appellee, and they are brought to this Court on appeal from the Circuit Court for the Southern District of New York by the defendant below.

ABSTRACT OF PLEADINGS.

Suit No. 87, Record pp. 7, 8, 9.

BILL OF COMPLAINT.

Suit No. 87.

1, Sets forth grant of Letters Patent to R. A. Tilghman, appellee, for fourteen years from January 9, 1854.

2, An adjudication under said patent on final hearing in the Circuit Court for the Southern District of Ohio.

3, The reduction of the patented improvement to use.

4, The infringement by the appellant.

ANSWER.

Suit No. 87.

The answer in suit No. 87.

1. Admits the granting of Letters Patent.

2, Admits the adjudication in the Southern District of Ohio, under said patent.

3, Denies that the appellee has applied his improvement to practical use.

4, Alleges that the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure, cannot be accomplished so as to be practically useful, if it can at all, by the method and apparatus described in said Letters Patent.

5, Alleges that all attempts to carry on the manufacture of fatty acids by means of the apparatus and method described in said Letters Patent have failed.

6, Denies that appellant has been using the improvement of Tilghman, or "any method in construction or *operation* substantially the same, *otherwise than is thereinafter alleged.*"

7, Admits that appellant used *water at a high temperature,* and steam, and *such pressure* as arises from the expansive force of *hot water* or steam in a *close* vessel, under and in pursuance of a patent of Wright & Fouche, January 25, 1859.

8, Alleges that "the action of *water highly heated in a close vessel upon very many substances* to decompose *them,* and upon

fats and oils," was prior to Tilghman's invention well known to chemists, etc., and was described in printed publications.

9, Alleges that before the invention of appellee "the use of a close vessel of such strength as to resist the pressure of the water when heated, or *any needed pressure* when using water to decompose *other* substances, was known to and practised by men of science and manufacturers in the United States and elsewhere."

10, That the said quality of highly heated water thus used is an elementary principle and *not patentable.*

11, Appellant has cited in his answer, at page 9, or under notice at p. 101, record No. 87, numerous prior patents and publications, as anticipating appellee's invention. These patents and publications will be found as defendant's Exhibits 1 to 20 at pages 232 to 247, Record No. 87.

The prior references as to novelty may be thus grouped:

1st. Extracts showing use of digesters, such as Papin, for general purposes. (This contains merely general reference to use of close vessels for heating water to high temperature and still retaining it in a *liquid* state.)

Exhibit No. 14, Record No. 87, p. 240.

2d. Extracts showing use of digesters for rendering raw fat or removing the membraneous and cellular matter and thus purifying it.

Manicléers' Patent, Exhibit 15, page 241, Record 87.

3. Extracts from text book and writers stating that neutral fats can be decomposed into fat acids and glycerine, and that in the act of decomposition the elements of the water are taken up by the fat acids and glycerine.

Dumas' Chemistry, Exhibit No. 7, Record No. 87, p. 236.

Dumas' Chemistry, Exhibit No. 3, Record No. 87, p. 233.

Thenard's Chemistry, Exhibit No. 2, Rec. No. 87, p. 232.

Berzelius' Chemistry, Exhibit No. 11, Rec. No. 87, p. 238.

Berthellot's Ann. de Chimie, Exhibit No. 16, Rec. No. 487, p. 241.

Pelouze and Fremy's Chemistry, Exhibit No. 19, p. 245.

4th. Extracts to show that alkaline saponification decomposes neutral fat into soap and glycerine, which soap can afterwards be decomposed into fat acid; and also to show that the *alkaline saponification* can be better effected in a close vessel under pressure. Record, 87.

Chevreul's Patent, Exhibit 18, p. 244. Rec. No. 87.

Dumas' Chemistry, Exhibit 3 and 7, *supra.*

Thenard's Chemistry, Exhibit 1, *supra.*

5th. Extracts stating that fats can be distilled in the presence of steam into *fat acids,* which are passed over as vapors and condensed in the still.

Debrunfaut's Patent (1841), Exhibit 4, Record 87, p. 233.

Scharling's Essay, Exhibit 10, Record 87, p. 237.

Regnault's Chemistry, Exhibit 20, Record 87, p. 245.

Pelouze and Fremy's Chemistry, Exhibit 19, Rec. 87, p. 245.

6th. Extracts to show use of highly heated water to decompose fats, but *of a date subsequent to appellee's patent.*

Berthelot's Ann. de Chimie (1854), Exhibit 16, Record 87, p. 241.

Berthelot's Academy Report (1854), Exhibit 17, Record 87, p. 244.

DECISION OF THE COURT.

Mr. Justice Nelson's opinion will be found at Record 87, pages 98 to 101, holding

1. That the appellee's invention consists of a *process* for producing free fat acids and solution of glycerine from fats and oils.

2. That "for this purpose he subjects the fatty or oily bodies to the action of *water* at a high temperature and pressure, so as to cause the elements of these bodies to combine with water, and thereby obtain at the same time free fat acids and glycerine."

3. That appellee purposes to do this in any convenient vessel of the requisite strength, and that although under the law he describes two vessels or apparatus for doing it, there is no claim for any special vessel or machine.

4. That appellee's patent does not require that the vessel should be absolutely *full of water* and fat.

5. That the appellee's patent does *not require the use of a heat* so high as melting lead, but merely prescribes it as a maximum, and announces that no fixed degree of heat can be given, as the different fatty or oily substances that may be used will require different degrees, and that by starting the vessel at a low heat and gradually increasing it, the best temperature may be ascertained for the particular substance used.

6. That upon a proper interpretation of the patent, the process could be and has been proved to have been carried into successful operation by the means pointed out by the patentee.

7. That "prior to the date of appellee's invention, there were but two modes known or in practical use for decomposing fatty substances, and obtaining from them fatty acids and glycerine. One called the lime saponification, and the other known as the distillation process," and that they were different from patentees—more expensive and tedious, and have generally gone

Dumas' Chemistry, Exhibit No. 3, Record No. 87, p. 233.

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3. That appellee purposes to do this in any convenient vessel of the requisite strength, and that although under the law he describes two vessels or apparatus for doing it, there is no claim for any special vessel or machine.

4. That appellee's patent does not require that the vessel should be absolutely *full of water* and fat.

5. That the appellee's patent does *not require the use of a heat* so high as melting lead, but merely prescribes it as a maximum, and announces that no fixed degree of heat can be given, as the different fatty or oily substances that may be used will require different degrees, and that by starting the vessel at a low heat and gradually increasing it, the best temperature may be ascertained for the particular substance used.

6. That upon a proper interpretation of the patent, the process could be and has been proved to have been carried into successful operation by the means pointed out by the patentee.

7. That "prior to the date of appellee's invention, there were but two modes known or in practical use for decomposing fatty substances, and obtaining from them fatty acids and glycerine. One called the lime saponification, and the other known as the distillation process," and that they were different from patentees—more expensive and tedious, and have generally gone

out of use in this country and England since appellee's invention.

8. That appellee was the first person that discovered the chemical fact that fatty or oily substances could be decomposed, and that the fatty acids and glycerine separated by the action of water at a high temperature and under pressure.

9. That it is immaterial to enquire whether defendant's vessel or machinery is similar to that described in appellee's patent; they constitute no part of his invention.

10. That appellant has manufactured fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure, according to the process explained by appellee in his specification, and hence has infringed his patent.

INTERLOCUTORY DECREE.

Mr. Justice Nelson awarded an injunction, and made a reference to K. G. White, as Master, to take an account of "*the gains and profits * * which have arisen or accrued to appellant from infringing*," *etc.* The issuing of the usual perpetual injunction was, at the instance of the appellant, ordered by the Court to be stayed until the entry of the final decree, upon the appellant giving a bond to account to appellee for the gains and profits, &c., which he might make during the interval. This bond was given. See Record 87, p. 417.

APPELLEE'S POINTS UNDER THE REFERENCE TO THE MASTER.

1. Under this reference the appellee offered much testimony to prove the following points:

"1. That appellant had made a profit by the saving of the "quantity of lime and sulphuric acid which had been previously "used by him in his old process, to produce the fat acids and

"glycerine which he afterward produced (without using any "lime or sulphuric acid) by the sole action of water at a high "temperature and pressure.

"2. That the quantity of lime and sulphuric acid thus saved "by appellant was thirteen and a half pounds of lime, and "twenty seven pounds of sulphuric acid, on each one hundred "pounds of fat decomposed into fat acids and glycerine, by the "action of water at a high temperature and pressure.

"3. That appellant had made a profit by the saving of a "certain quantity of fat which was formerly lost and thrown "away with the refuse sulphate of lime produced in his old "process, but which fat was no longer lost since his use of "appellee's process, in which no refuse sulphate of lime was "produced or thrown away.

"4. That the quantity of fat thus saved by appellant was "two pounds on each one hundred pounds of fat decomposed "into fat acids and glycerine by the action of water at a high "temperature and pressure.

"5. That the quantity of fat decomposed by appellant into "fat acids and glycerine, by the action of water at a high "temperature and pressure, up to the ninth day of January, "1868, had amounted to eleven million five hundred and two "thousand eight hundred and ninety-two pounds, (11,502,892 "pounds.)

"6. That a saving of thirteen and a half pounds of lime, "twenty-seven pounds of sulphuric acid, and two pounds of "fat, upon each one hundred pounds of fat decomposed, had "been made and realized by appellant upon the said eleven "and a half million pounds of fat decomposed into fat acids "and glycerine.

"7. The values or market prices of the lime, sulphuric acid "and fat, at the several dates when saved by appellant, were "stated by appellant himself in his testimony.

"8. That appellant had made a profit by the increased "strength, purity and value of the glycerine obtained by his "use of the appellee's process, as compared with that obtained "by his former process.

"9. That this increase of value of the glycerine amounted to "one-fifth of a cent on each pound of fat from which the "glycerine was utilized and obtained, by the action of water at "a high temperature and pressure.

"10. That the quantity of fat from which the glycerine was "utilized and obtained by appellant, by the action of water at "a high temperature and pressure, had amounted to ten mil-"lion three hundred and thirty-seven thousand one hundred "and forty-seven pounds, (10,337,147 pounds) down to the "expiration of the first term of the appellee's patent.

"11. That the profits made by appellant by his use of "appellee's process, amounted to the principal sum of one hun-"dred and sixty thousand six hundred and ninety-nine $\frac{5}{100}$ "dollars, ($160,699.05), being the value of the following articles "saved. at their market price when saved, viz.:

"Lime saved,	1,552,889 lbs.	Value,	$11,243 26
"Sulphuric Acid saved,	3,105,778 "	"	100,663 51
"Fat saved,	230,057 "	"	28,118 01
"Profit on Glycerine obtained from 10,337,147 lbs. of fat, $\frac{1}{5}$ cent per lb. fat, ...			20,674 27
			$160,699 05

together with interest on said sums from the dates when the saving was realized.

APPELLANT'S POINTS UNDER THE REFERENCE TO THE MASTER.

Although the appellant did not dispute by proofs or argument that he decomposed fatty bodies into fat acids and glycerine, by the action of water at a high pressure and temperature,

and that by the *process* which he used the saving claimed was effected.

Yet the appellant offered much testimony to prove and in the argument insisted

1. That appellant worked at a lower temperature than that designated by appellee's patent, and took more time in the operation, and employed a continued agitation or circulation of the fat, water, and steam.

2. Appellant insisted that no mention was made in appellee's patent of the means to produce *agitation* and *circulation* of the fat and water, and without agitation or circulation the employment of heat and pressure would result in no pecuniary profit.

3. Appellant gave much testimony to prove that appellee's process, carried out as described in his patent, is not practicable or practical.

Master's Report.

After much testimony had been submitted to the Master, and the above points presented to him by Apellees, he reported to the Court "that no gains or profits had been proven *to have been received by, or to have arisen or accrued to, the appellant* from the manufacture, use, or sale of the patented improvement." Record No. 87, p. 408.

Appellee's Exceptions to Master's Report.

To this report sixteen exceptions were filed by appellee. Record No. 87, p. 408. The first eleven exceptions mainly proceeded upon the ground that the Master had refused to find according to these eleven points above set forth by appellee.

DECISION ON EXCEPTIONS TO MASTER'S REPORT.

Mr. Justice Nelson's health having become impaired, the cause came before Judge Blatchford for argument on the exceptions filed by appellee to the Master's report, and that Judge allowed the first eleven exceptions of appellee, stating, also, in his opinion, "that as the calculations based on the evidence taken before the Master, and furnished by the plaintiff, *show just how much* the plaintiff is entitled to recover, it is unnecessary to send the case back to the Master."

Judge Blatchford thereupon estimated the *savings* for each year, proved to have been effected by the appellee's patented process according to the eleven points taken by appellee before the Master, and in his exceptions down to the expiration of the first term of the patent.

Judge Blatchford further allowed to appellee, interest "from and after the close of each year, on the ascertained value of the savings and profits for the twelve months next preceding."

OPINION OF JUDGE BLATCHFORD. (9 Blatchford, p. 14).

1. "It is a mistake to contend that the plaintiff does not, in "his specification, enforce the necessity of keeping up an inti- "mate mechanical mixture of the fat and water during the "operation. He directs that the fat and water shall be mixed, "and he calls, in many places, the liquid that is being operated "upon, a mixture. His description and drawing of the coil "apparatus state and show, that a disc or piston, perforated "with numerous small holes, is kept in rapid motion up and "down in the vessel into which the fat and water are first put, "to cause them 'to form an emulsion or intimate mechanical "mixture.' He also states, in reference to the coil apparatus, "that 'it is important for the quickness and perfection of the "decomposition, that the oil and water, during their entire

" passage through the heating tubes, should remain in the same " state of intimate mixture in which they enter them;' and he " suggests two devices for maintaining such thorough mixture. " It is impossible to maintain the proposition that the plain- " tiff's specification ought not to be construed as fully disclos- " ing the desirableness of keeping the fat and water intimately " mixed during the operation, with a view to effecting a speedy " and complete decomposition, as well when the 'convenient " vessel' first named is used, as when the coil apparatus is " used. The evidence is, that the decomposition will take place " without mixture, in a time proportioned to the degree of heat " and the extent of the area of surface contact between the fat " and the water. Having indicated the propriety of using " means to maintain an intimate mixture of the fat and water, " the plaintiff is entitled to use, in carrying out his process, " any means then known and used in the same art for main- " taining a mixture of fat and water. In the lime saponification " process, the stirring or agitation of the fat, water and lime " during the process, in order to keep up an intimate contact " between the particles, was employed; and the proofs show the " description or use, before the date of the plaintiff's patent, of " a vertical churn agitator to mix fat, water and lime, while " being boiled in an upright boiler under pressure, of a rotary " paddle wheel agitator to mix fat, water and lime, while being " boiled in a horizontal boiler under pressure, and of a stirrer " rotating on a vertical shaft, to mix fat, water and lime, while " being boiled in an open tub. The plaintiff's specification is " addressed to persons skilled in the department of manufactur- " ing to which it is applicable; and the evidence is abundant to " show, that such persons would have understood, as a matter " of course, that, with a view to practical and profitable manu- " facturing, there must be agitation of the mass, and would " have readily used known devices at hand to produce such " agitation.

2. " The defendant has entirely failed to show that the plain- " tiff's process, carried out as described in his patent, is not

" practicable or practical. It was put in practical operation in " London in 1857, a patent having been taken out for it in Eng- " land by the plaintiff, January 9th, 1854. It was put in opera- " tion in Cincinnati, Ohio, in 1860, and has been in use, under " license from the plaintiff, in the United States, ever since, " there being ten factories in the United States working under " such license. The defendant was notified by the plaintiff in " September, 1860, not to infringe the patent, and what he has " done has been done wilfully and not innocently."

3. " It is abundantly shown, that the saving of lime and " sulphuric acid and fat, and the increased profit from the " glycerine produced, result from the use of the plaintiff's pro- " cess, and not from the special apparatus of Wright and Fouché. " Such apparatus is one means of producing stirring or agita- " tion and mixture. The plaintiff's process, when carried on " with other means of maintaining the mixture, produces, as is " shown by the evidence, the same saving of lime and sulphuric " acid, which is produced by the defendant in using the Wright " and Fouché apparatus; and such apparatus is useless, unless " a high heat and pressure be employed. The defendant pre- " viously used the lime saponification process, and abandoned it " for the plaintiff's process. He must be regarded as having " made, directly, by using the plaintiff's process, the saving of " lime, sulphuric acid and fat, and the profit in respect of glyce- " rine, which existed between the use of the two processes, and " which saving and profit he would not have made if he had " continued to use the old process. He has not made the " saving by using the Wright and Fouché mixing apparatus. " Ropes used the heat and pressure with a paddle wheel mixer, " and made the saving of lime and sulphuric acid. Jones used " a pump to mix, with heat and pressure, and made the same " saving.

4. "The use of superheated water is the effective decompos- " ing agent in the defendant's process. If the use by the " defendant of the Wright and Fouché mixing apparatus saves

" labor or fuel, as compared with any prior process, the plain-
" tiff is not entitled to the saving thus effected. *But, the defen-*
" *dant has not shown any such saving of labor or fuel.* The
" proof as to the saving of lime, sulphuric acid and fat, and as
" to the increased profit on the glycerine produced, at the quan-
" tities and values set forth in the plaintiff's exceptions, is full
" and clear.

"On the hearing, the defendant's counsel did not dispute,
" that, if the saving of the lime, sulphuric acid and fat was due
" to the use of the plaintiff's process, the plaintiff was entitled
" to the value of such saving, as profits. That is undoubtedly
" a correct principle, as applicable to an accounting for profits,
" in a case of this description, in equity.

"The plaintiff's exceptions, above set forth, must be allowed.
" But, as the calculations based on the evidence taken before
" the Master, and furnished by the plaintiff, show just how
" much the plaintiff is entitled to recover, it is unnecessary to send
" the case back to the Master. The account was taken down to
" the expiration of the patent, on the 9th of January, 1868.
" The savings are calculated at 13½ pounds of lime, 27 pounds
" of sulphuric acid and two pounds of fat, on each 100 pounds
" of fat worked. This, at the prices shown by the evidence,
" makes the saving in the aggregate, of lime, sulphuric acid and
" fat, $140,024.78. The increased profit on glycerine, at one-
" fifth of a cent per pound on the quantity of fat worked, was
" $20,674,27. The saving of lime, sulphuric acid and fat is
" calculated from and including the 1st of July in each year,
" to and including the 30th of June in the following year,
" covering the period from and including December, 1860, to
" and including January 9, 1868. The increased profit on the
" glycerine is calculated from and including the 1st of January
" in each year, to and including the 31st of December in the
" same year, but only covers the fat worked from and including
" July 1, 1861, to and including January 9, 1868. I think
" that the plaintiff is entitled to interest from and after the

" close of each of such years, on the ascertained value of the " savings and profits for the twelve months next preceding. " Making up the account on these principles, gives the follow- " ing results:

SAVINGS OF LIME, SULPHURIC ACID, AND FAT.

For the year ending	Quantity of Fat Worked.	Value of lime, Sulphuric Acid and Fat saved.	Interest to September 1st, 1871.		
			Years.	Per Cent.	
June 30, 1861..	1,165,745 lbs.	$ 8,996 86	10 1/6	71 1/6	$6,402 77
" " 1862..	1,502,316 "	11,063 28	9 1/6	64 1/6	7,098 94
" " 1863..	1,050,426 "	8,718 84	8 1/6	57 1/6	4,984 27
" " 1864..	1,395,142 "	14,556 26	7 1/6	50 1/6	7,302 39
" " 1865..	1,993,051 "	33,993 58	6 1/6	43 1/6	14,673 90
" " 1866..	1,613,263 "	26,254 43	5 1/6	36 1/6	9,495 35
" " 1867..	2,001,162 "	28,344 58	4 1/6	29 1/6	8,267 17
To Jan. 9, 1868..	781,787 "	8,096 95	3 23/36	25 17/36	2.062 47
	11,502,892 lbs.	$140,024 78			$60,287 26

INCREASED PROFIT FROM GLYCERINE SOLD.

For the year ending	Amount received for Glycerine sold.	Quantity of Fat Worked.	Profit at ½ of a cent per lb. of fat worked.	Interest to Sept. 1, 1871. Years.	Per Cent.	
Dec. 31, 1862..	$6,048 32	1,502,316 lbs.	$3,004 63	8⅔	60⅔	$1,822 81
" " 1863..	7,543 97	1,050,426 "	2,100 85	7⅔	53⅓	1,127 46
" " 1864..	16,330 16	1,395,142 "	2,790 28	6⅔	46⅔	1,302 13
" " 1865..	15,273 70	1,993,051 "	3,986 10	5⅔	39⅔	1,581 15
" " 1866..	17,804 88	1,613,263 "	3,226 52	4⅔	32⅔	1,054 00
To Jan. 9, 1868..	35,777 94	2,782,949 "	5,565 89	3$\frac{23}{36}$	25$\frac{17}{36}$	1,417 76
	$98,774 47	10,337,147 lbs.	$20,674 27			$8,305 31

This makes the total amount for which the plaintiff will be entitled to a decree, September 1, 1871, $229,291.62. Let a decree be entered, of that date, for that amount, with costs.

Final Decree.

Proceeding upon this estimate, as set out in this opinion (9 Blatchford's Reports, 167), the following decree was entered by Judge Blatchford: "it is ordered, adjudged, and decreed, that the plaintiff do recover of the defendant the sum of $\$229,826\frac{63}{100}$ as profits, which sum is made up from estimated savings of lime, sulphuric acid, and fat, and increased profits from glycerine sold, amounting together to $\$66.699\frac{05}{100}$, and interest on such savings from and after the close of each year, on the ascertained value of the savings and profits for the twelve months next preceding, and amounting to $\$69,127\frac{58}{100}$, and the sum of $\$954\frac{98}{100}$ as costs, making in all $\$237,781\frac{61}{100}$."

CASE NO. 340.

Abstract of Pleadings.

Bill of Complaint.

Sets out:

1. Grant of same patent to appellee as mentioned in former suit, and its *extension* for seven years.

2. That appellant has continued to infringe the appellee's patent since the granting of the extension.

3. The proceedings in the prior suit against the appellant in the same court.

Defendant's Answer.

1. Alleges that decision in former suit was made on an incomplete presentation of the prior state of the art.

2. That Judge Nelson erred in the first decision, in supposing that the specification of appellee did not require the vessel containing the mixture of water and fat to be *entirely filled*, and that *no steam* was to be permitted in it. Record No. 340, p. 15.

3. That the application for extension of appellee's patent was not *made* in conformity with law; that notice of such application was not published as required by law; that the patent was extended by fraud and collusion of appellee and Commissioner of Patents, and extended patent is, therefore, void.

4. That prior to the obtaining of his original patent of Oct. 3, 1854, appellee had obtained an English patent for same invention, which English patent had expired previous to the extension, and no prolongation of the appellee's patent could be legally granted.

5. Denies that appellee has ever applied his invention to practical use.

6. That no sufficient or adequate means are described in the appellee's patent, whereby the invention can be reduced to practice: That the mode described as the best mode of carrying the invention into effect by appellee, is pernicious and dangerous, owing to the degree of heat and pressure required, and would result in the destruction of the glycerine, and be otherwise impracticable.

7. That the claim in appellee's patent does not contain a patentable subject matter.

8. Denies infringement, but admits that appellant has continued to use the same process since the extension of appellee's patent, which he was using at the time of the commencement of the former suit, and describes it as it is described in Wright & Fouché's patent.

9. Describes the old process used by appellant, and admits that fourteen pounds of lime and twenty-eight pounds of sulphuric acid were used for each one hundred pounds of fat treated.

10. Admits that since the date of extended patent, (Jan. 9, 1868,) appellant has decomposed into fat acids and glycerine four and a half millions of natural fat, *saving* by the process used by him, 630,000 pounds of lime, 1,160,000 pounds of sulphuric acid; and also admits that there may have been two per cent. of fat saved, and that the solution of glycerine obtained is of greater strength and purity than that obtained by the old process.

11. Sets out as showing want of novelty of said alleged in-

vention, new references, not in evidence in the former answer, which may be grouped as follows:

1. Notice of certain changes in fat which occurred in Perkins' engine in 1823, published in London Quarterly Journal, 1823. Exhibit 1 and 2, Record 87, p. 388, Perkins' patent.

2. Article on change in castor oil, noticed on surface of cistern of a water barometer, published in Transactions of Royal Society, 1832. Exhibit 9, Record 87, p. 389.

3. Extract on lime saponification under pressure. Encyclopedie Roret., 1849. Exhibit 5, Record 87, p. 89.

4. On steam distillation of fats and fatty acids, by Payen. Exhibit 8, Record 340, p. 88.

5. On decomposition of volatile fatty acids. Exhibit 11, Record 87, p. 239.

6. References are given in the answer to Maniclér's patent, who was mentioned in the first answer, and to Appert, who is not given in evidence as an exhibit. [These were all parties who "*rendered*" raw fat with water under pressure into merchantable fat according to appellee's theory of the case.]

MOTION FOR INJUNCTION HEARD ON BILL, ANSWER AND STIPULATED PROOFS.

The appellee having given notice of a motion for special injunction, it was heard before Judge Blatchford on the bill and answer, and all the proofs contained on these appeal records, except the small amount of testimony embraced between page 549 and 576 of Record No. 340. See stipulation, page 21, Record No. 340, dated May 30, 1871.

Decision of Judge Blatchford.

The case was argued in July, 1871, and Judge Blatchford decided the following points: 9 Blatchford, rep. p. 27.

"*So too*, the fact that the use of the Wright and Fouché "process is an infringement of the patent (of Tilghman) can- "not be doubted.

"The objection that the plaintiff's invention as described in "his patent cannot produce the result claimed in the patent, "has been considered and disposed of adversely to the defend- "ant, in the decision given on the hearing on the exceptions to "the Master's report in the former suit against the defendant.

"The objection that the decision of Mr. Justice Nelson was "made under a misapprehension on his part as to the mode of "operation in the process described in the plaintiff's patent, "is also without foundation. It is alleged, that Mr. Justice "Nelson considered that the plaintiff's specification did not "require, either that the vessel containing the mixture of water "and fatty matter should be entirely filled therewith, or that "no steam was to be permittted in it; and that the specifica- "tion makes both such conditions necessary. On full consider- "tion, I concur in the views of Mr. Justice Nelson on these "points, and have no doubt that his interpretation of the "specification in regard to them was correct.

"As to the validity of the extension, as it is regular on its "face, no question of irregularity or fraud in granting it can "be raised by an infringer, in a suit against him for infringe- "ment. (Railroad *vs.* Stimpson, 14 Peters, 458; Stimpson *vs.* "Railroad, 4 Howard, 404; Rubber Co. *vs.* Goodyear, 9 Wal- "lace, 796; Seymour *vs.* Osborne, 11 Wallace, 543, 545.)

"The expiration of the English patent before the patent for "the United States was extended, formed no objection to such "extension.

"In the decision of the Court, given by Judge Emmons, in "the two suits brought in Ohio in 1868, he used this language: "'Although the record in this case, in reference to some views

"which a superior Court may possibly take, contains some "material additional proofs,' (beyond those in the previous case "in Ohio, and those before Mr. Justice Nelson in the case in "this Court,) 'still they are not such as to authorize the same "Court to overrule its former deliberate adjudications, and to "disregard the judgments of a co-ordinate one, in a case in all "respects substantially like it. Especially is this so, where the "judge delivering the opinion has taken so leading a part in all "the discussions upon this subject in the Court of last resort. "After much consideration, I am confident that, without a "violation of judicial propriety and the best interests of all who "pursue or defend here, the cases already decided between "these same parties must be followed. It would greatly im- "pair the influence of the Court and the confidence of the "suitors, if any succeeding judge turned it into one of appeal "for all questions previously decided. Where doctrines are "reconsidered, as often they are and should be, the circum- "stances of the case must be exceptional, and furnish the jus- "tification for the action in each instance where it is taken. "There are none such in this case. More than ordinary de- "liberation attended the previous discussions and judgments." "These are wise and sound views, and are fitly applicable to "the action of this Court on the present motion. Nothing is "now presented to this Court which would authorize it to over- "rule the deliberate adjudication formerly made by it. That "adjudication is fortified by the decisions of the Court in "Ohio.

"The point urged, that the defendant uses a different degree "of heat and a different pressure from those set forth in the "plaintiff's patent, is considered and disposed of by Mr. Jus- "tice Nelson, in his opinion.

"In support of the objection, that the plaintiff never applied "to practical use the improvements described in his patent, "and that they are incapable of being applied to practical use, "the defendant relies on two letters written by the plaintiff—

"one dated London, June 25, 1856, to Thomas Emery & Son, "of Cincinnati, and the other dated London, July 20, 1857, to "M. de Fontaine Moreau. But these letters lead to the "opposite conclusion. The first letter shows, that the plaintiff "had, in factories in London and Paris, exposed the fat and "water to a higher heat and pressure for a shorter time, and "to a lower heat and pressure for a longer time, and had come "to the conclusion that the latter mode of operation was the "more convenient one, and had, in connection with it, used an "agitator, in an ordinary digester; and that he was about "putting up, at Price & Co.'s works, in London, an apparatus "on that plan, capable of heating several tons per day. The "lower heat and pressure are within the patent, as has been "shown by Mr. Justice Nelson; and the question of the use of "an agitator was considered in the opinion given on the hear-"ing of the exceptions to the Master's report in the former "suit in this Court against the defendant. The second letter "shows, that, at the time it was written, the plaintiff's process "was being successfully worked in the factory of Price & Co., "in London, at a moderately low pressure. In 1860, the "plaintiff's process was put into practical use in Cincinnati, in "an old form of apparatus. In 1862, it was put into use in "Cincinnati, under license from the plaintiff, in another old and "different form of apparatus; and, by 1867, ten factories in the "United States were working the process under such license. "In September, 1860, the defendant was notified by the plain-"tiff, in writing, not to infringe the patent by using the pro-"cess he has used; but, in December, 1860, he commenced to "practically operate with the Wright and Fouché apparatus, "and he has ever since continued to do so.

"The defendant, in using the apparatus described by him in "his answer as that which he uses, uses the plaintiff's process, "and infringes the patent. The process he used down to the "time he adopted the plaintiff's process was the lime-saponifica-"tion process. He now saves the lime and sulphuric acid which "he used in that process, and also saves fat and obtains a solution

"of glycerine of greater strength and purity. The answer admits, "that, up to the time it was put in, the defendant had, since "the ninth of January, 1868, decomposed into fat acids and "glycerine about 4,500,000 pounds of fat, and saved, by the "use of the Wright and Fouché apparatus, about 630,000 "pounds of lime, and about 1,160,000 pounds of sulphuric "acid. If the price of lime be taken at only $\frac{75}{100}$ of a cent per "pound, and the price of sulphuric acid at only $2\frac{1}{2}$ cents per "pound, the saving of lime for forty months would have been "$4,725, and the saving of sulphuric acid for the same time "would have been $29,000. The saving of fat, at two per "cent. of the fat worked, would have been 90,000 pounds for "the forty months, equal, at 12 cents per pound, to $10,800. "If the increased profit on glycerine, by reason of its greater "strength and purity, be called one-fifth of a cent per pound "on the fat worked, such profit for the forty months would "have been $9,000. Thus, the defendant may be properly "regarded as having saved, in forty months, by the use of the "plaintiff's process, $53,525, or at the rate of $1,338.12 per "month. The bases of calculation are those established on the "hearing before the Master in the former suit in this Court "against the defendant, and the result shows the direct saving "of profit which the defendant is making by continuing his "infringement.

"The *defendant points to nothing in the six publications and "patents which his answer sets up, and which had not, in previous "suits, been set up or introduced in evidence*, which goes to "destroy the novelty of the plaintiff's invention, and there is "nothing in the other fifteen to justify the witholding of an "injunction."

"*The great merit and value of the plaintiff's invention, not "only in the manufacture of candles, but as a process for "obtaining pure glycerine for use in the arts, are shown by "evidence, and it is quite time that he should have effective pro-"tection.* After the decision in his favor by Mr. Justice Nel-"son, on final hearing, a perpetual injunction would undoubtedly

"have been ordered to issue, as a part of the interlocutory "decree, but for some special considerations which induced the "judge to suspend the injunction until the final decree, if the "defendant should give a bond in $20,000, conditioned to pay, "on final decree, either in this Court or in the Supreme Court, "all sums of money which should be found due from him to "the plaintiff on the accounting before the Master, on the "filing and confirmation of the report on such accounting. "The bond was given and no injunction was issued. If the "original term of the patent had not expired, a perpetual in-"junction would now be ordered, as a part of the final decree. "The plaintiff ought to be in no worse position because his "patent has been extended and he is compelled to make the "present motion. I see no ground for allowing a bond to be "given in this suit. as security, in place of issuing an injunc-"tion. The case is a clear one, on all points. Let an injunction "issue, according to the prayer of the bill."

INTERLOCUTORY DECREE.

After this decision the appellant took a license from appellee and filed the testimony embraced in pages 549 to 576 of Record No. 340, and the case was set down for final hearing. The appellees having on the motion for preliminary injunction fully argued the matter before Judge Blatchford on substantially the same record, waived argument on the final hearing, and the usual interlocutory decree for an account was entered. The appellee also waived a reference to a Master, whereupon the Court inserted the following as a part of the interlocutory decree:

"And it is further ordered, that the reference to the Master to ascertain the gain and profits hereinbefore decreed, having been waived by both parties, the same is reserved for the further hearing of this Court."

The appellee then filed a computation which the appellant agreed to be a correct one, calculated on the basis of the Court's decree in the former case. See stipulation and computation Record, No. 340, p. 622 to 625.

The following decree was then entered by the Court on this stipulation.

"This cause came on to be heard in pursuance of the order herinbefore made, May 31, 1872, and the said plaintiff having been heard by George Harding, and the defendant by Charles M. Keller and S. D. Law, Esq., it is ordered, adjudged, and decreed, that the plaintiff do recover of the defendant the sum of one hundred and six thousand three hundred and seventy dollars and twenty-four cents as profits, and fifty-three dollars and twenty cents costs, making in all one hundred and six thousand four hundred and twenty-three dollars and forty-four cents, this first day of September, 1872."

Record No. 340, p. 629.

(Signed,) SAM'L BLATCHFORD.

APPELLEE'S POINTS.

I.

Appellee's patent is for a process and is patentable, and not for a mere philosophical principle unapplied to practical use.

O'Reilly *vs.* Morse, 15 How., 62.

Household Co. *vs.* Neilson Webster, Pat. cases, 683.

Corning *vs.* Burden, 15 How., 267.

II.

The mention of the use of a "convenient vessel" in appellee's patent, is sufficient without further description or reference to known existing apparatus.

Household Co. *vs.* Neilson, 1 Webster, Pat. cases, 687.

Emerson *vs.* Hogg, 2 Blatchford, 9.

Brooks *vs.* Jenkins, 3 McLean, 447.

S. P. Kneass *vs.* Schuylkill, 4 Wash., 13.

III.

Appellant infringes by the use of highly heated water under pressure to decompose fat into fat acids and glycerine. Appellee's patent is not limited to specific degrees of temperature.

Mowry *vs.* Whitney, 15 Wallace, 636.

Goodyear *vs.* Wait, 3 Fisher, 248.

American Wood Paper Co. *vs.* Glenn Falls Co., 4 Fisher, 328.

IV.

The mere suggestions of actual and possible modes of operation in prior books or patents, is not sufficient to invalidate

a patent for a process reduced to practice and adequately described.

Curtis on Patents, § 378.

Bettz *vs.* Menzies, 7 Law Times, N. S., 110.

Household Co. *vs.* Neilson, 1 Webster Pat. cases, 690.

V.

Appellee's patent is not void for want of practical utility, or because lower temperatures are generally used than those pointed out in appellee's patent, or because there may be inconvenience in working his process at the maximum temperature mentioned by him.

Mowry *vs.* Whitney, 14 Wallace, p. 646.

Tilghman *vs.* Mitchell, per Nelson, J., Record 87, p. 98.

Tilghman *vs.* Mitchell, per Blatchford, J., 9 Blatchford, p. 28.

VI.

APPELLEE'S EXCEPTIONS TO MASTER'S REPORT.

The Appellee excepted to the report of the Master in case No. 87, because "the Master erred in not reporting the following facts as proved," and the Court below were right in allowing these exceptions:

"1. That appellant had made a profit by the saving of the "quantity of lime and sulphuric acid which had been previously "used by him in his old process, to produce the fat acids and "glycerine which he afterward produced (without using any "lime or sulphuric acid) by the sole action of water at a high "temperature and pressure.

"2. That the quantity of lime and sulphuric acid thus saved "by appellant was thirteen and a half pounds of lime, and "twenty seven pounds of sulphuric acid, on each one hundred "pounds of fat decomposed into fat acids and glycerine, by the "action of water at a high temperature and pressure.

"3. That appellant had made a profit by the saving of a "certain quantity of fat which was formerly lost and thrown "away with the refuse sulphate of lime produced in his old "process, but which fat was no longer lost since his use of "appellee's process, in which no refuse sulphate of lime was "produced or thrown away.

"4. That the quantity of fat thus saved by appellant was "two pounds on each one hundred pounds of fat decomposed "into fat acids and glycerine by the action of water at a high "temperature and pressure.

"5. That the quantity of fat decomposed by appellant into "fat acids and glycerine, by the action of water at a high "temperature and pressure, up to the ninth day of January, "1868, had amounted to eleven million five hundred and two "thousand eight hundred and ninety-two pounds, (11,502,892 "pounds.)

"6. That a saving of thirteen and a half pounds of lime, "twenty-seven pounds of sulphuric acid, and two pounds of "fat, upon each one hundred pounds of fat decomposed, had "been made and realized by appellant upon the said eleven "and a half million pounds of fat decomposed into fat acids "and glycerine.

"7. The values or market prices of the lime, sulphuric acid "and fat, at the several dates when saved by appellant, were "stated by appellant himself in his testimony.

"8. That appellant had made a profit by the increased "strength, purity and value of the glycerine obtained by his "use of the appellee's process, as compared with that obtained "by his former process.

"9. That this increase of value of the glycerine amounted to "one-fifth of a cent on each pound of fat from which the "glycerine was utilized and obtained, by the action of water at "a high temperature and pressure.

"10. That the quantity of fat from which the glycerine was "utilized and obtained by appellant, by the action of water at "a high temperature and pressure, had amounted to ten mil- "lion three hundred and thirty-seven thousand one hundred "and forty-seven pounds, (10,337,147 pounds) down to the "expiration of the first term of the appellee's patent.

"11. That the profits made by appellant by his use of

"appellee's process, amounted to the principal sum of one hun-
"dred and sixty thousand six hundred and ninety-nine $\frac{5}{100}$
"dollars, ($160,699.05), being the value of the following articles
"saved. at their market price when saved, viz.:

"Lime saved,	1,552,889 lbs.	Value,	$11,243 26
"Sulphuric Acid saved,	3,105,778 "	"	100,663 51
"Fat saved,	230,057 "	"	28,118 01
"Profit on Glycerine obtained from 10,337,147 lbs. of fat, $\frac{1}{8}$ cent per lb. fat, ...			20,674 27
			$160,699 05

together with interest on said sums from the dates when the saving was realized.

VII.

The savings made by appellant by use of appellee's process, is the measure of his liability in an equitable account.

Mowry *vs.* Whitney, 14 Wallace, p. 651.

Sickels *vs.* Gloucester Manufac'g Co., 2 Fisher, P. C., 222.

Household Co. *vs.* Neilson, Webster, Pat. cases, 697.

Tyndall *vs.* Michigan Southern R. R., 1 Fisher, 297,

VIII.

The extension is valid on its face. It's validity cannot be impeached in this suit.

ARGUMENT FOR APPELLEE.

Prior to the invention of Tilghman, it was known that neutral fats could be decomposed into fat acids and glycerine, and that, in the act of decomposition, these products absorbed the elements of water into their constitution. To effect this chemical decomposition of fats, two modes were attempted or practised, viz.: alkaline saponification and distillation. The former produced both fat acids and glycerine; the latter (prior to Tilghman's invention) produced fat acid but did not produce glycerine as a result. This subject is fully discussed on page , *post.*

Tilghman's invention was of a "manufacture" or an "improvement in manufacture" of fatty acids and glycerine, that is, the manufacture of old things in a new way. It was therefore directly within the words of the Act of Congress, authorizing the granting of patents. See Act of 1836.

In the case of Corning *vs.* Burden, 15 Howard, p. 267, this Court said, "A process, *eo nomine*, is not made the subject of a patent in our Act of Congress. It is included under the general term 'useful art.' * * * * Where the result or effect is produced by *chemical action*, by the application or operation of some element or power of nature, or of one substance to another; such modes, methods, or operations are called *processes. A new process is usually the result of a discovery.*"

The new process of Tilghman was based upon the discovery which he had made, viz.: that water, highly heated and retained in a liquid state (that is, prevented from being converted into steam) in a close vessel under pressure, possessed the *chemical power* of decomposing neutral fats into fat acids and glycerine.

Tilghman, in his patent, announces his discovery and also describes two modes of carrying out his process based thereon.

The first mode is announced by him in the following language: (Record No. 87, p. 4.)

"My invention consists of a process for producing free fat acids and solution of glycerine from those fatty and oily bodies of animal and vegetable origin, which contain glycerine as their base. For this purpose, I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine. I mix the fatty body to be operated upon with from to a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting point of lead, until the operation is complete. The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam."

In connection with this description in the specification of Tilghman, the then existing condition of apparatus in the art of treating fat should be understood.

In the alkaline saponification processes, which were in use prior to Tilghman's invention, closed boilers, provided with safety valves, were known. In fact the safety valve was considered an indispensable appendage to a closed boiler from the time of Papin, 1682. It was also known that fat and water would tend to remain unmixed in a boiler, and therefore agitators or circulators, for preserving a mixture or intimate contact between the fat and lime and water during the process of alkaline saponification, were in use.

These apparatus were proved to have existed, by the testimony of Professor Booth, and also by prior patents and publications. Thus:

In Radley and Meyers' patent, fat and water and alkali were boiled under pressure in a vessel made as shown in Figure 1, which it will be noticed was a closed boiler and had a safety valve and a revolving mechanical agitator. See Record 87, p. 264.

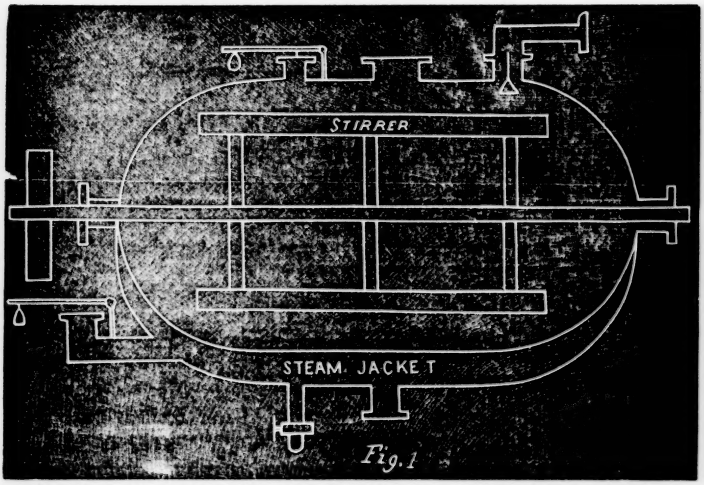


Fig. 1

Figure 2 represents a close boiler, used for treating fat, lime and water with a churn-like agitator, which was described by De Milly in 1834. (Record No. 87, p. 264.)

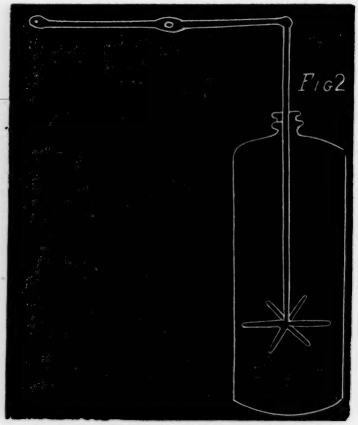
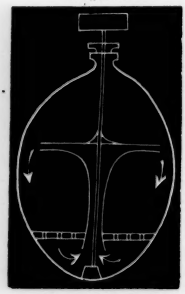


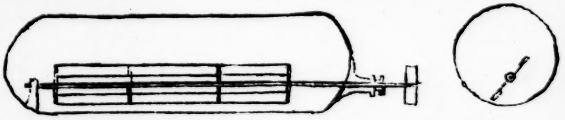
Figure 3 represents an apparatus used by Alliot in 1851, consisting of a closed boiler used for heating fat, alkali, and water together, in which a rotary pump was used to draw up the water and alkali from below and discharge it continuously on top of the fat, through which fat the water and alkali continually descends. See Record No. 87, p. 264.

Fig. 3.



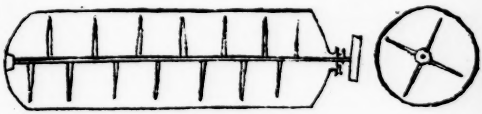
Apparatus used by Plf^s licensee. R. Ropes.
Horizontal boiler with rotating paddles

Fig. 1.



Apparatus commonly known and used before 1854.
Figures 2, 3, 4 and 5.

Horizontal boiler with rotating paddles.
Fig. 2
Morfit.
1841.



Horizontal boiler with rotating paddles.
Radley & Meyer
1851.
Fig. 3.

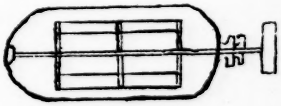
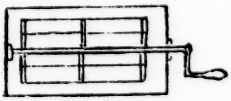
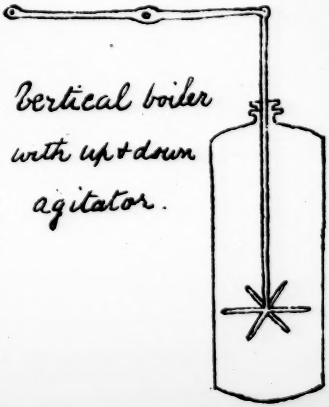


Fig 4.



Common barrel
Churn.

Fig. 5. De Milly 1834.



Vertical boiler
with up & down
agitator.

Apparatus used by Plff. Licensee. C. J. Jones.

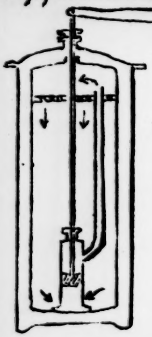


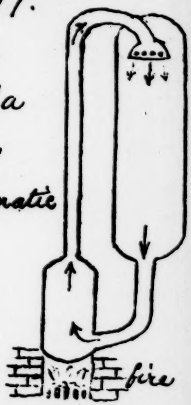
Fig 6

Vertical boiler with pump to draw water from bottom and spread in on top in a shower of drops.

Apparatus used by Defendant. Wright & Fouché's Pat. 1857.

Fig. 10.

The ascending power of a column of heated water causes a continuous automatic circulation.



Apparatus commonly known and used before 1854. Figs. 7, 8, and 9.

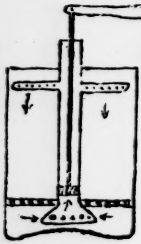
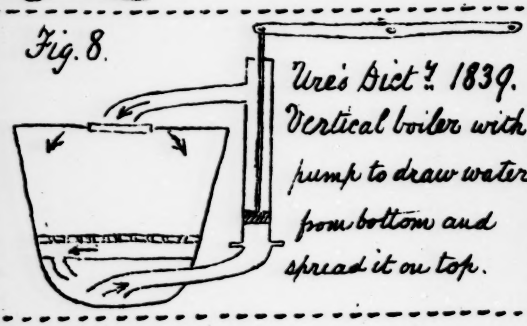


Fig. 7. Berthollet. 1824.

Vertical boiler with pump to draw water from bottom and spread it on top in drops

Fig. 8.



Ure's Dict.y 1839.

Vertical boiler with pump to draw water from bottom and spread it on top.

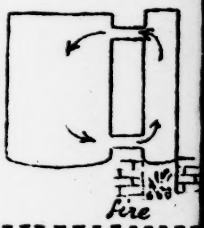
Fig. 9. Alliott. 1851.

Vertical boiler with centrifugal pump to draw water from bottom and spread it on top.

Apparatus commonly known and used before 1857. Figs. 11, 12, 13, 14 and 15.

Floyd. 1795. Fig 11.

The ascending power of a column of heated water causes a continuous automatic circulation



Ure's Dict.y 1839. Fig. 12

A column of heated water and steam ascends and causes a continuous automatic circulation

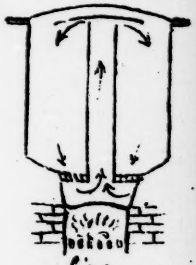


Fig. 13.

Dict: de l'Industrie

1834.

A column of heated water and steam ascends and causes a continuous automatic circulation

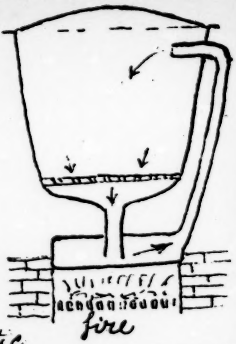


Fig. 14

Mather 1853.

Heat and circulation by a jet of steam

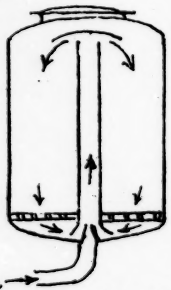
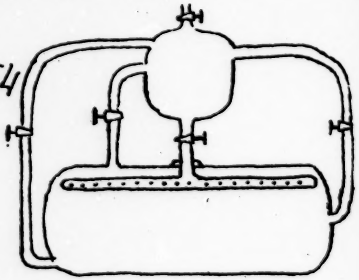


Fig. 15.

Melsens 1854



Circulation of heated water in small drops through fat to produce fat acids and glycerine.

It has been frequently decided that known machines need not be described when they are to be used in carrying out a new patented invention.*

---

*In Household & Co. *v.* Neilson—Webster's Patent Cases, p. 687, the Court says:

"Now I have to observe to you that the specification is to be read as addressed to artists or persons of competent skill in the branch of manufacturing, or process to which it is applicable. *Hence known machines n ed not be described when the use of them is to be made in carrying out the object of the patent.* For instance, if in an apparatus for improving the making of gas, a pa'entee should not mention or allude to a condenser, never notice it; yet in practice, if that is a part of all apparatus required in the making of gas, it was held that every one must know that a condenser must be used.

"In short, you are speaking to people who know the subject, and must be understood to know those things which are only the incidents in the particular process to which your patent applies."

The American decisions are to the same effect.

Emerson *vs.* Hogg, 2 Blatchford, 9.

"Old and well known machinery with which the new contrivance is to be connected, need not be described in the specification or delineated in the drawings, when no change in their forms or proportions enter into the new invention."

Brooks *vs.* Jenkins, 3 McLean, 447.

"Parts of machinery and processes generally known need not be described."

Same point in Kneass *vs.* Schuylkill Bank, 4 Wash., 14.

After describing his continuous apparatus, Tilghman gives the following general instructions in his specification.

"The melting point of lead has been mentioned as the proper "heat to be used in this operation, because it has been found to "give good results. But the change of fatty matters into fat "acid and glycerine takes place with some materials (such as "palm oil) at, or below, the melting point of bismuth, yet the "heat has been carried considerably above the melting point "of lead without any apparent injury, and the decomposing "action of the water becomes more powerful as the heat is

"increased. *By starting the apparatus at a low heat, and "gradually increasing it, the temperature giving products, most "suitable to the intended application of the fatty body employed, "can easily be determined.* Record No. 87, p. 4.

Mr. Tilghman also prescribes in his specification certain thermometric tests for carrying on the process.

"To indicate the temperature of the tubes *d, d, d,* I have "found the successive melting of metals and other substances "of different and known degrees of fusibility to be convenient "in practice; several holes, half an inch in diameter, and two "or three inches deep, are bored into the solid parts of the "castings surrounding the tubes, each hole being charged with "a different substance. The series I have used consist of tin "melting about 440° F., bismuth at about 510° F.; lead at "about 612° F.; and nitrate of potash at about 660° F." Record, No. 87, p. 6.

TILGHMAN'S CONTINUOUS APPARATUS.

Tilghman, in his patent, also describes a special apparatus, by which his process may be carried on *continuously* "by causing the mixture of fatty matter and water to pass through a tube "or continuous channel," and illustrates it by a drawing.

The feature of this second form of apparatus consisted in making a *tube* of such length that the mixture of fat and water might be passed gradually through the tube and be treated in the passage, so as to come out at the end decomposed into fat acid and glycerine.

The marked features of this special apparatus were

1st. A continuous tube, arranged so as to be heated along its entire length.

2d. A pump to force the materials in at one end.

3d. A spring valve at the other end, to permit the escape of the fat acids and glycerine at that end, and yet retain the contents under the requisite pressure.

It will be seen that the length of tube and degree of heat and the frequency of discharge, might be so regulated that the pump might be vibrated at regular intervals, and a fresh supply of material forced in at one end, and of decomposed products be forced out at the other. If steam were permitted to accumulate and displace the water away from the fat in the tube, the decomposition would not take place regularly.

This continuous apparatus is fully shown in the drawing of appellee's patent at page 6, Record No. 87.

Having thus shown two modes of carrying out his process, one in ordinary close vessels known in the arts, and the other in a *continuous* method of operation in a special apparatus, and having also stated temperatures at which he had worked well, and having given a rule by which the temperature can be fixed by any one, he claims no special apparatus and no special temperature, but he declares

"I claim, as of my invention, the manufacturing of fat acids and glycerine from fatty bodies *by the action of water at a high temperature and pressure.*"

Introduction into Use.

Tilghman patented his process in England Jan. 9th, 1854, and introduced it there both in his continuous method and in the ordinary digester.

George F. Wilson stated in a public lecture delivered by him in January, 1856, (see Record No. 87, p. 96.)

G. F. Wilson, Jour. Society of Arts, London.

"In January, 1854, Mr. Tilghman, an American chemist, who has studied all that has been published here and in France, on the subject of acidification and distillation of fatty bodies, obtained a patent for exposing fats and oils to the action of water

at a high temperature, and under great pressure, in order to cause the combination of the water with the elements of the neutral fats, so as to produce at the same time free fat acids and solution of glycerine. He proposed to effect this by pumping a mixture of fat and water, by means of a force pump, through a coil of pipe heated to about 612 Fahrenheit, kept under a pressure of about 2,000 pounds to the square inch; and he states, that the vessel must be closed, so that the requisite amount of pressure may be applied to prevent the conversion of water into steam. This is, all must admit, *a beautiful, original,* chemical idea, *well carried out*; it has yet to be proved how far it can compete successfully with distillation. We have made an arrangement with Mr. Tilghman which will give us the means of testing its commercial merits."

In July, 1857, Tilghman introduced his process into Price's candle factory in London, in an *ordinary long boiler with a revolving stirrer,* working at a temperature of about 400° Fah. (225 pounds pressure,) and having a capacity of treating two and a half tons of fat daily. This appears by a letter of appellee, given in evidence by appellant, at page 406, Record No. 87, in which it is stated.

TILGHMAN'S LETTER, JULY 20, 1857.

Defendant's Exhibit B.—December 24, 1868. R. E. S.

LONDON, *July 20, 1857.*

To M. DE FONTAINEMOREAU:

DEAR SIR:—In compliance with your request, I proceed to describe the present state of the apparatus for decomposing fats, as it is now being worked at Messrs. Price & Co.'s.

As I have before mentioned to you, it consists of a boiler thirty-two inches diameter, and thirty feet long, made of iron nine-sixteenths thick, and lined with copper.

It is heated by an interior copper serpentine, "a retour d'eau," which is supplied with steam from a smaller tubular boiler, (thirty-two inches diameter by ten feet long, with eighteen flues, three inches diameter.) It also has a tube pierced with holes to inject free steam. The apparatus is worked at a

"COMPLAINANT'S EXHIBIT EMERY. (Rec. 340, p. 362.)

"14 SOUTHAMPTON PLACE, EUSTON SQARE,

"LONDON, *June 25th*, 1856.

"THO'S EMERY & SON, *Cincinnati.*

"GENTLEMEN: I have received from Mr. Davenport your favor of 30th May last. Our experiments in the factories here and in Paris have shown that, on the large scale, the decomposition of fats by water is more conveniently effected by modifying the apparatus originally proposed, so that the fat and water are exposed to a comparatively lower heat and pressure for a longer time, instead of a very high pressure for a few minutes; and a considerable quantity of material is *treated at one charge, in an ordinary steam-boiler*, lined with lead or copper, and provided *with an agitator*, in place of using the continuously working pumps and coil of pipes. At a pressure of 225 pounds per inch, tallow, or palm oil, or lard stearine is completely decomposed in five hours. In the course of a few months we shall probably have going on at Price & Co.'s works an apparatus on the above plan capable of treating *several tons* per day. Until my process is in actual use in England I have decided not to begin its introduction into the United States, and therefore cannot at present reply to your request as to terms of sale. As soon as *it is well established here* I intend returning home, and will immediately communicate with you. I give below answers to such of your questions as I have materials for, and remain, very respectfully, yours, R. A. TILGHMAN."

pressure of from two hundred to two hundred and twenty-five pounds per square inch, (fourteen to fifteen atmospheres;) it is charged with two and a half tons palm oil and three quarter tons water, and the oil is perfectly decomposed in four and a half hours after the above pressure is attained. *The decomposition would be effected in shorter time if a larger proportion of water was employed, and if agitation and mixture of the materials was produced by thei njection of free steam from the pierced tube,* but as one object is to get the glycerine in a strong state, (the demand for glycerine being just now greater than they can supply,) they prefer for the present to work it as described.

Price & Co. are now thinking of putting up another apparatus, which will probably be constructed to work at a pressure considerably higher than above mentioned, so as to shorten the time of decomposition, and also will *be made to work continuously so as to avoid loss* of time in filling and emptying.

Very truly, yours,

R. A. TILGHMAN,

14 Southampton Place.

It appears by a letter given in evidence by appellant at page 353 of Record No. 340, that this apparatus continued at work at Price's factory down as late as 1865. See Tilghman letter, admitted in evidence at page 353, Record 340.

COMPLAINANT'S EXHIBIT WILSON.

PRICE'S PATENT CANDLE COMPANY, LIMITED.

BELMONT WORKS, BATTERSEA, LONDON, S. W., July 13, 1865.

R. A. TILGHMAN, ESQ.,

1123 Spruce Street, Philadelphia,

DEAR SIR:—I thank you for your letter of 19th of June, which I have laid before the directors to-day, and they will be much obliged if you will, as you kindly offer, procure for us tracings of the working drawings of the apparatus now in use for your process in America, and most approved of by you, at any such cost as you mention—of about twenty dollars. You will tell us, in sending them, how to pay the money.

You are right in supposing that the apparatus we have now at

Battersea is just what you saw or heard about when you were here. There is a stirrer in each vessel, but plainly insufficient for the proper contact of the water with the fatty body. I should think, we may very probably use our present digesters for the outer iron vessels of your apparatus, putting them, of course, up on their ends. They are very much the shape of the vessels you describe. You do not mention what quantity of water you put to the fat. I should think it might be well to put it in at two doses—drawing off the first where it has taken up the bulk of the glycerine, and then finishing off with fresh water, to take the last part of it away, using this water again as the first water, for a fresh change of fat; but very likely you already do this. The whole of your letter now being replied to, as well as of the previous one, was of much interest to us. If any further matters occur to you as worth mentioning in connection with the working of the process on your side, we shall be much obliged by your stating them when you write again.

I am, dear sir, yours, faithfully,

J. P. WILSON.

While Tilghman was introducing his process into use in the form of the old convenient vessels in England he also endeavored to induce parties in France to introduce it in the continuous form of operation. Meanwhile Tilghman returned to the United States and introduced his process at Rope's factory, in Cincinnati, in 1860. At Rope's factory they used a long closed boiler with a revolving stirrer, and worked at a temperature of 367° Fah. (150 pounds pressure). Record 87, page 103. This apparatus went into operation in January, 1860, and decomposed 9,000 pounds of fat per day, and has continued in operation. After Tilghman's process had been introduced* into use at Price's, in London, and Rope's, in Cincin-

*In 1862 Tilghman put in operation his process at the factory of C. T. Jones, Cincinnati, using an old and well-known form of apparatus, similar to Alliot's boiler, where the water was continually pumped up and discharged on top of the fat. This process was worked upon charges of 6,000 pounds daily, under Tilghman's license.

It is further in evidence that in 1867 ten factories in the United States were working the water process under license from the appellee. Record No. 87, page 358.

nati, in an ordinary closed vessel with a stirrer, Tilghman learned that the appellant had infringed, or intended to infringe his patent, and addressed to him a note, to be found at page 79 of Record No, 87, as follows:

COMPLAINANT'S EXHIBIT M².

"*September 6, 1860.*

"R. G. MITCHELL, New York:

"*Sir*:—Please to take notice that the process of manufacturing fat acids by the action of water at a high temperature and pressure, now pursued by you, is an infringement of Letters-Patent of the United States granted to Richard A. Tilghman, dated 3d October, 1854, and that you desist from its further use without my license.

"Your obedient servant,

"R. A. TILGHMAN,
"*1114 Girard Street,*
"*Philadelphia.*"

The notice of which the above is a copy was delivered to R. G. Mitchell in person, September 6, 1860, by me.

B. C. TILGHMAN.

In disregard of this notice the appellant proceeded to erect boilers and infringe the patent of appellee, and in December, 1860, went into full operation. See Record No. 87, p. 253.

INFRINGEMENT.

1. Tilghman announces in his patent that highly heated water under pressure, would of itself decompose neutral fat into fat acid and glycerine.

EXTRACT FROM APPELLEE'S SPECIFICATION.

"My invention consists of a *process* for producing free *fat acids* and *solution of glycerine* from those fatty and oily bodies of animal and vegetable origin which contain glycerine as their

base. For this purpose, I subject these fatty or oily bodies to the action of *water* at a high *temperature* and *pressure*, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine." Record 87, p. 4.

2. He announced that in order to carry out his process it was necessary to have a strong vessel, and closed so as "*to prevent the conversion of the water into steam, i. e.*, to retain the water in a liquid state at the same time it was exposed to the high degree of heat.

3. Tilghman mentioned in his specification, that as the heat is increased, the time of decomposition is diminished. Record 87, p. 6. "The decomposing action of the water becomes more powerful as the heat is increased."

4. He mentions ranges of temperature to be worked out, and provides convenient thermometric apparatus for testing those temperatures, *viz.:* from 440° F. melting point of tin, to bismuth at 510°, and lead at 612°

5. He mentions in *three* places that it is important to maintain the fat and water in an intimate state of mechanical mixture or contact during the operation.

Although Tilghman makes these five announcements, yet in the first part of his specification, where he states the nature of his invention, he limits himself to no precise temperature, provided that *water* highly heated and under *pressure*, be used to decompose fats.

So also in the claim, he defines his invention as consisting in the use of highly heated water under pressure, to produce fat acids and solution of glycerine.

Appellee insists that the use of highly *heated water* under pressure, to decompose neutral fats into fat acids and glycerine is

an infringement of his patent, no matter what particular form of apparatus be used, or what particular temperature be adopted, and no matter what particular device be adopted to maintain the intimate mechanical mixture of the fat and water during the decomposing operation; these last being obvious matters of detail, susceptible of infinite variety.

The infringement of the appellant consists in placing highly heated *water* with neutral fat into a close vessel, and restraining or confining it there under pressure to preserve the water in a liquid state, and thereby produce fat acid and a solution of glycerine.

1. Appellant uses highly heated *water* under pressure as the decomposing agent. This appears from the Wright & Fouché patent, under which appellant swears that he works. (*See appellant's answer.*)

EXTRACT FROM ANSWER, RECORD NO. 87, P. 8.

"And that in the process of such manufacture he uses water "at a high temperature, and steam, and such pressure as arises "from the expansive force of *hot water* or steam in a close vessel, "*under and in pursuance of letters patent of the United States "granted to Robert A. Wright and Louis J. Fouche*, bearing "date the 25th day of January, 1859, *to which*, when produced, "the defendant refers."

The patent of Wright & Fouché shows exclusively that highly heated *water* and not steam is the agent relied upon for decomposing the fat.*

* In the argument below for appellant, the presence and great importance of *steam* as well as heated water and fat was insisted on as making a vital difference between Wright and Fouche's process and that of Tilghman's and it was said appellant's *method wholly depends* on the presence of fat, water and *steam*. If this be true Wright & Fouche must have been ignorant of the fact, for neither the use nor even the existence of *steam* in their apparatus is anywhere mentioned by them in their patent.

EXTRACT FROM WRIGHT & FOUCHE PATENT, REC. NO. 87, P. 79.

"The *superheated water* in the boiler *a* acquires an ascending "motion on account of the difference in the temperature of the "two capacities *a* and *h*; a current is thus created, whence it "results that the *heated water* in boiler *a* ascends through the "tube *g* into the cylinder *h*, and being forcibly driven out "through the holes in the rose jet, passes through the fatty "bodies and descends again through the tube *f* to the bottom "of the boiler *a*, where it is again warmed, in order to "recommence its ascending motion, and so on.

"In conclusion, we would remark that we are aware that: "Firstly, the decomposition of fatty bodies by *water* under the "influence of heat and of pressure is a well-known scientific "fact.

"Claims: Having described the nature of our invention and "the manner in which the same is to be performed, we do not "claim the application of *superheated water* for decomposing fatty "bodies, nor the form of the apparatus above described, which "may vary somewhat according to conditions and circumstances; "but what we *claim* as our invention is: producing a continuous "automatic circulation of *highly heated water*, in a very finely "divided state, through the bodies under treatment, by means of "an apparatus constructed and employed substantially as herein "shown and described."

ROBERT A. WRIGHT,
L. FOUCHE.

See also the following correspondence of Wright & Fouché with the Patent Office. REC. NO. 87, P. 79.

"The claim now presented is limited to their means of "producing the continuous circulation of *water* in a very finely "subdivided state through the matters under treatment.

"(P. 80.) The object of the petitioners is to decompose all "fatty bodies by means of *water, pressure and heat.*

"This decomposition is a subdivision of the fatty bodies into "stearic, margaric and oleic acids, and into glycerine.

"The fatty acids combine with the water to form stearates, "margarates, oleates, &c., of water, and the glycerine falls to "the bottom, dissolved in the water, uncombined with the fat "acids."

Admission of appellant's witnesses, that highly heated water under pressure is employed by appellant.

Verdin, Jr., Record 87, p. 126.

Q. 131. What is the degree of heat to which the water in the lower boiler is subjected, or rather to which it is raised?

A. About 374° Fahrenheit's scale.

Q. 132. Is it at the same degree when acting upon the fats?

A. It is when it first comes in contact with the fats, and it may lose a little while operating upon them.

Verdin, Sr., Record 87, p. 146.

We fill the lower boiler with sufficient water, so that it goes three inches above the bottom of the upper boiler, and then fill the upper boiler with fat within two feet of the top, then we put a fire under it till we get it up to one hundred and eighty pounds pressure, keep it there for eight or nine hours, according to the quality of the fat.

Verdin, Jr., Record 87, p. 201.

X. 40. Do you mean, by the last answer, to say that the effect of the pressure, which is required in the Wright & Fouche apparatus, as used by the defendant, is to preserve the *water in a liquid state at a high temperature* in the presence of fat?

A. Yes, sir; I think that is about the effect of it.

The same result is produced that Tilghman produces. (*See extract from Wright & Fouche's Patent.*) *Record 87, p. 231.*

When this operation has been thus continued during a length of time which may vary from five to eight hours, according to the nature of the fatty bodies operated on, and also according to the variation of pressure (varying from ten to twenty atmospheres), the *fatty bodies are decomposed into glycerine*, which remains dissolved in the water, *and into fatty acids*, which float into the cylinder *h*; the contents are now emptied out and separated from each other at the same time.

The announcement made in the Wright & Fouche patent, that as the heat or pressure is increased, the time is diminished, was first made by Tilghman, and is borrowed from him by Wright & Fouche.

TILGHMAN'S PATENT.

"The decomposing action of the water becomes more powerful as the heat is increased."

WRIGHT & FOUCHE.

"When this operation has been thus continued during a length of time which may vary from five to eight hours, according to the nature of the fatty bokies operated on, and also *according to the variation of pressure*, (varying from ten to twenty atmospheres), the fatty bodies are decomposed into glycerine, which remains dissolved in the water, and into fatty acids, which float in the cylinder *h*."

The announcement that the maintaining an intimate contact or mixture between the fat and water during the decomposition was important, was first made by Tilghman and borrowed by Wright & Fouché.

EXTRACT FROM TILGHMAN'S PATENT. RECORD No. 87, P. 6.

"It is important, for the quickness and perfection of the decomposition that the oil and water, during their entire passage through the heating tubes, should remain in the same state of *intimate mixture* in which they enter them.

I believe that it will be found useful to fix at intervals, in the heating tubes, diaphrams pierced with numerous small holes, so that liquids, being forced through these obstructions with great velocity, may be *thoroughly mixed together*."

WRIGHT & FOUCHE PATENT. RECORD No. 87, P. 232.

"But what we claim as our invention is: producing a continuous automatic circulation of highly heated water, in a *very finely divided state*, through the bodies under treatment, by means of an apparatus constructed and employed substantially as herein shown and described."

ROBERT A. WRIGHT,
L. FOUCHE.

Wright & Fouché admit that they derived from others the knowledge:

1. That water highly heated under the pressure would decompose facts;

2. That an intimate mechanical mixture or contact was important to expedite it;

And all they pretend to claim is that they invented a peculiar mode of effecting this intimate mixture of fat and water.

EXTRACT FROM WRIGHT & FOUCHE PATENT, RECORD NO. 87, PAGE 231.

"In conclusion, we would remark that *we are aware that: Firstly*, the decomposition of fatty bodies by water under the influence of heat and of pressure is a well-known scientific fact. 'Water is substituted for the organic basis; it forms a perfect and fixed combination with the fatty acids, while the glycerine is dissolved in the excess of water.'

Secondly, That as this chemical action takes place under the influence of a weak affinity, it is necessary in addition to the above-named physical and chemical conditions, to insure a perfect molecular agitation of the whole mass."

LETTER OF WRIGHT & FOUCHE'S AGENT TO COMMISSIONER OF PATENTS, RECORD NO. 87, P. 79.

"The claim now presented is limited to *their means* of producing the continuous circulation of water in a very finely subdivided state through the matters under treatment."

WRIGHT & FOTCHE'S PATENT CLAIMS, REC. NO. 1, P. 232.

"Having described the nature of our invention and the manner in which the same is to be performed, we *do not claim* the application of *superheated water* for *decomposing fatty bodies*, nor the form of apparatus above described which may vary somewhat according to conditions and circumstances; but what we claim as our invention is, *producing* a continuous automatic

circulation of a highly heated water, in a very finely divided state, through the bodies under treatment *by means of an apparatus* constructed and employed substantially as herein shown and described."

ROBERT A. WRIGHT,
L. FOUCHE.

The appellee's witnesses, Booth, Rogers, Genth, Bridges, and Gibbs, all testify that the appellant's process is identical with that patented to Tilghman.

Prof. J. C. Booth, Record 87, p. 27.

6. State whether the process of decomposing fat into fat acids and glycerine, described in said patent of Wright & Fouche is the same or different from the process described and claimed in said patent of Tilghman. (Objected to by defendant's counsel, as not within the province of an expert.

A. It is the same.

Prof. Robt. E. Rogers, Record 87, p. 60.

4. Have you read, and do you understand the patent granted to Wright & Fouche, No. 22,765?

A. I have read and do understand the same.

5. Is the method of obtaining fat acid and solution of glycerine from neutral fatty bodies therein described the same, or a different process from that described in complainant's patent? (Objected to as not within the province of an expert.)

A. I consider it to be identical.

Prof. Robert Bridges, Record 87, p. 66.

Q. 5. Have you examined, and do you understand the Letters-Patent of Wright & Fouche, No. 22,765?

A. I have read, and do understand them.

Q. 6. Please state whether or not the process of decomposing fats in said process is the same, or different from that set forth in complainant's patent? (Same objection.)

A. I consider the process of decomposing fats, as set forth in the patent of Wright & Fouche, to be identical with that set forth in the patent of Tilghman.

Prof. F. A. Genth, Record 87, p. 70.

Q. 3. Have you read, and do you understand, the patent granted to R. A. Tilghman, No. 11,766, and also the patent granted to Wright & Fouche, No. 22,755? and if yea, state whether the process of decomposing fats directed to be performed in Wright & Fouche's apparatus is the same or a different process from that described in Tilghman's patent? (Objected to as not within the province of an expert.)

A. I have read, and do understand, both patents mentioned in the question, and consider the process performed in either to be identical.

Prof. Wolcott Gibbs, Record 87, p. 10.

Q. 3. Have you read, and do you understand, the patent granted to the plaintiff, dated October 3, 1854?

A. I have read it, and do understand it.

Q. 4. Have you read, and do you understand, the patent granted to Wright & Fouche, dated January 25, 1859?

A. I have read it, and understand it.

Q. 5. (Objected to as incompetent.) State whether liquid water, highly heated and under pressure, is, or is not, the agent in both these patents by which fatty bodies are decomposed into fat acids and solution of glycerine?

A. I believe that it is.

The testimony of Gibbs should have especial weight, because not only of his high standing as a chemist, but because he was deliberately selected by the appellant to examine these subjects, and because he made up his mind adversely to appellant without ever having known or seen Mr. Tilghman or any one on his behalf.

It is also to be borne in mind by the Court that Professor Gibbs, after a full examination of the subject on *behalf of appellant*, formally reported to him that *Tilghman's process was new.*

No expert produced by appellant has sworn that Tilghman's process is substantially the same with that described in any

exhibit, or was ever known or used before the date of his patent.

No expert has ever sworn that appellant's process is substantially different from that patented to Tilghman, while *five experts* of the highest scientific merit, unhesitatingly swear to the novelty of Tilghman's invention, and to the fact of infringement by appellant.

The only point that appellant makes on the question of infringement is that he uses a lower temperature than that stated by Tilghman to be his preference.

The reasoning of appellant on this point seems to lead to an absurdity. He says, in effect. that the general does not include the particular, and that after the general announcement that water at a high temperature and pressure would decompose fats, it still remained unknown that it would do so at *any particular* high temperature and pressure.

It would follow logically from this, that the day after appellee's patent, another person could have obtained a valid patent for using the same process at all temperatures not specifically mentioned by appellee; and that each succeeding day a new valid patent could be obtained for the same process, applied at each particular degree of temperature, and that the last patent as to its specified degree, would be better in law than the first one, which announced the broad general discovery.

Appellee's discovery was that water at a high temperature and pressure had a certain chemical power; that it was for this purpose a new chemical agent. If his discovery had been that nitric acid would produce fat acids, and he had said, I prefer to use strong nitric acid of 20° B., but weaker acid will act less powerfully, and I claim the use of nitric acid generally,

could defendants have used nitric acid of 1° B., and said that it was a different invention?

Appellants' experts are compelled to admit that the chemical action of water upon fat is the same at 300° as at 612° F., and is merely slower at the lower temperature. Wayne, Record No. 340, p.

X Q. 153. Then I understand you to say that from 300° F. to over 612° F., the chemical action of water upon fat to produce fat acid and glycerine, is substantially the same; is that so?

A. That is so.

(Dr. Rand, Record 340, p. 503.)

X Q. 61. Then if in operating with fat and liquid water alone at 320° F., any part of the fat is converted into fat acids and glycerine, the process chemically considered, is the same as complainant's patented process; is that so?

A. It is.

In attempting to show some difference between the first and the second case, the appellant has made a rather ludicrous change of front as to one position originally taken.

The learned counsel formerly insisted that the whole benefit derived by the appellant from his use of appellee's process arose from the perfect and continuous mixture and contact of the fat and water produced by the Wright and Fouché apparatus, and they loudly asserted that the practical success of the process, even in the forms of apparatus used by appellee's licensees, was due to their borrowing this most important principle.

In their second case they produce Mr. Renwick and Mr. Verdin, who testify that in the appellant's operation in the Wright and Fouché apparatus, *the fat and water are never intimately mixed*, and that, therefore, his process differs from, and does not infringe upon, appellee's.

Renwick—appellant's additional testimony, Record 340, p. 564.

Q. 11. I visited the establishment of defendant and saw the apparatus in operation which were there used for decomposing fats. I had portions of the contents drawn from different parts of each apparatus; I found that the water and fat were not maintained in a state of admixture, the fat in one portion of the apparatus being practically free of water, and the water in another part of the apparatus being practically free of fat.

F. Verdin, Sr—Appellant's partner, Record No. 340, p. 574.

Q. 6. In the defendant's apparatus referred to by you in your answer, is there, during the process of decomposing the fat, any admixture or emulsion of the fat and water?
A. Not the least.

The fallacy of the experiment described by these witnesses is self evident on an inspection of the drawing of appellant's apparatus (Record No. 87, p. 231.) While a copious shower of drops of water was falling *in the centre* of the vessel, plunging through the fat to the bottom, and there separating, they take samples from cocks opening *in the side of the vessel, out of the track of the falling drops*, and, of course, obtain only fat or water nearly free from each other.

If they had arranged a funnel, opening upwards in the centre of the vessel and *in the track of the falling shower*, and had taken their samples from that, they would evidently have obtained a quantity of both fat and water, showing the proportion in which they were mixed at the instant of the trial.

This new theory was started after Judge Nelson's and Blatchford's decision below, and is in direct conflict with the theory of appellant, as urged upon those Judges.

Before this new light had dawned upon him, Mr. Mitchell, the appellant, testified as follows: In Record No. 78, p. 358.

X Q. 32. All the manufacturers use lime enough to hold

the water in contact with the fat, or use a pump, or some other method of producing and retaining a mixture of the fat and water.

P. 359. X Q. 38. Lime, which has the properties of an alkali, is the cheapest and best agent to hold the moisture in contact with the fat, and consequently it was always used, and is yet to some extent, excepting at our works, where the *apparatus of Wright and Fouché causes a constant intermixture of the fat and moisture* by an automatic circulation. The agitator does not produce *as perfect a mixture of the fat and water as the Wright and Fouché apparatus*, or as the process by the pump, which was not introduced until September, 1863.

F. Verdin, appellant's witness, testifies. Record No. 340, p. 399.

X Q. 78. What is the use of circulation?

A. The use of circulation is to keep the water always in contact with the fat.

X Q. 79. Provided the water is kept in contact with the fat, does it make any difference how that contact is produced?

A. I do not suppose it does.

The expressions in Wright and Fouché's patent and correspondence, describing their process to be "a perfect molecular *agitation* of the whole mass," and "a continuous automatic circulation of highly heated water in a very finely divided state through the bodies under treatment," show that the production of an intimate mixture of the fat and water was the principal object of their apparatus.

Intimate mixture of the highly heated fat and water, though greatly accellerating the action, is not essential to appellee's process; mere quiet contact, long enough continued, will produce the decomposition, as shown by Booth's and Verdin's experiments, and the practical working at Price's factory in London.

Discussion of Legal Questions as to Scope of Tilghman's Patent, its Validity and Infringement.

It is argued for appellants that the claim of appellee's patent, if construed to cover all degrees of high temperature and pressure, and all forms of apparatus, is a claim for a principle, and is, therefore, invalid under the decision in O'Reilly *vs.* Morse, 15 Howard, 62, and hence the Court must limit it to his patented apparatus.

A full consideration of that decision, and the facts upon which it was based, as stated by Chief Justice Taney, will show a radical distinction between the two cases, and that O'Reilly *vs.* Morse, as well as Neilson *vs.* Harford, which Chief Justice Taney cites and approves, are authorities in favor of the patentability of Tilghman's claim construed in its broad sense.

"It is impossible to misunderstand the extent of this claim. "He claims the exclusive right to every improvement where the "motive power is the electric current, and the result is the mark- "ing or printing intelligible characters, signs or letters at a dis- "tance. If this claim can be maintained, it matters not by what "*process* or machinery the result is accomplished. * * * * "In fine he claims an exclusive right to use a manner and *process* "which he has *not* described and *indeed has not invented*, and "therefore could not describe when he obtained his patents. The "Court is of opinion that the claim is too broad and not war- "ranted by law. * * * * * * * * "The leading case upon this patent is Neilson v. Harford, in "the English Court of Exchequer. It was elaborately argued "and appears to have been carefully considered by the Court. "The case was this: Neilson in his specification described his "invention as one for the improved application of air to pro- "duce heat in fires, forges and furnaces, where a blowing appa- "ratus is required. And it was to be applied as follows: The "blast or current of air produced by the blowing apparatus "was to be passed from it into an air vessel or receptacle made "sufficiently strong to endure the blast, and through or from "that vessel or receptacle, by means of a tube or pipe, or "aperture, into the fire, the receptacle to be kept artificially

"heated to a considerable temperature by heat externally ap-
"plied. He then described in *rather general terms the manner*
"*in which the receptacle might* be constructed and heated and
"the air conducted through it to the fire, stating that the *form*
"*of the receptacle was not material, nor the manner of applying*
"*heat to it.* In the action above mentioned for the infringe-
"ment of this patent, the defendant, among other defences,
"insisted that the machinery for heating the air and throwing
"it hot into the furnace, was not sufficiently described in the
"specification, and the patent void on that account. *And also*
"*that a patent for throwing hot air* into a furnace *instead of*
"*cold,* and thereby increasing the intensity of the heat, was a
"patent for a principle and that a principle was not patentable.
"Upon the first of these defences the jury found that a man of
"ordinary skill and knowledge of the subject, looking at the speci-
"fication alone, could construct such an apparatus as would be
"productive of a beneficial result, sufficient to make it worth while
"to adapt it to the machinery in all cases of forges, cupolas and
"furnaces, where the blast is used. And upon the second
"ground of defence, Baron Park, who delivered the opinion of
"of the Court, said:

"It is very difficult to distinguish it from the specification
"of a patent for a principle, and this at first created in the minds
"of the Court much difficulty; but after full consideration, we
"think that the plaintiff does not merely claim a principle, but
"a machine embodying a principle, and a very valuable one.
"We think the case must be considered as if the principle being
"well known, the plaintiff had first invented a mode of apply-
"ing it by a mechanical apparatus to furnaces, and his invention
"then consists in this, by interposing a receptacle for heated
"air between the blowing apparatus and the furnace. In this
"receptacle, he directs the air to be heated by the application
"of heat externally to the receptacle, and thus he accomplishes
"the object of applying the blast, which was before cold air,
"in a heated state to the furnace."

"We see nothing in this opinion differing in any degree from
"the familiar principles of law applicable to patent cases.
"*Neilson claimed no particular mode of constructing the recepta-*
"*cle or of heating it.* He pointed out *the manner in which it*
"*might* be done, *but admitted that it might also* be done in a
"variety of ways, and *at a higher or lower temperature,* and
"that all of them would produce the effect in a greater or
"less degree, provided the air was heated by passing through
"a heated receptacle. * * * * * * *

"Undoubtedly the principle that hot air will promote the "ignition of fuel better than cold, was embodied in this ma- "chine. But the patent was not supported because this prin- "ciple was embodied in it. * * * But this patent was "supported because he had invented a mechanical apparatus, "by which a current of hot air instead of cold could be thrown "in. And this new method was protected by his patent. The "*interposition of a heated receptacle in any form* was the novel- "ty he invented. * * * And his claim, as the patent was "construed and supported by the Court, is altogether unlike "that of the patentee before us. Mr. Neilson *discovered* that "by interposing a *heated receptacle* between the blower and the "furnace, and conducting the current of air through it, the "heat in the *furnace was increased*, and this effect was always "produced, whatever might be the form of the receptacle or "the mechanical contrivances for heating it, or for passing the "current of air through it, and into the furnace."

"*But Prof. Morse has not discovered* that the electric or "galvanic current will always print at a distance, no matter "what may be the form of the machinery or mechanical con- "trivances through which it passes. To produce that effect, it "must be combined with and passed through and operate upon "certain complicated and delicate machinery, adjusted and ar- "ranged upon philosophical principles, and prepared by the "highest mechanical skill. And it is the high praise of Prof. "Morse that he has been able, by a new combination of known "powers, of which electro magnetism is one, to discover a "method by which intelligible marks or signs may be printed "at a distance. *And for the method and process thus discov- "ered*, he is entitled to a patent. But he has not discovered "that the electro-magnetic current used as motive power in "any other method and with any other combination will do as "well."

Now, to make Tilghman's case similar to Morse's 8th claim, it will be necessary to prove that the fact that highly heated water would decompose fats into fat acids and glycerine had been known to chemists for years before Tilghman's patent, and that it was generally believed that it could be successfully applied in practice, and that Tilghman was merely the first person to make and describe a machine by which it could actually be done.

If such were the facts, the Court might properly apply the rule in O'Reilly *vs.* Morse, and confine the patentee's claim to the machinery which he had invented to make a *previously known power* useful in practice.

As the facts really stand, however, Tilghman being the *first to discover the power* of water at a high temperature and pressure to convert fats into fat acids and glycerine, and also the first to propose to apply it to practice, and to describe a machine for doing it, saying at the same time that other forms of machine could be used, the case becomes exactly parallel to Neilson's, as stated by Chief Justice Taney.

The *method or process* of heating fat and water to a high temperature and pressure so as to produce fat acids and glycerine, becomes Tilghman's invention, and will be protected, no matter what form of machine be used to carry it out.

In Corning *vs.* Borden, 15 Howard, 267, Judge Grier says:—

"A process *eo nomine* is not made the subject of a patent in "our act of Congress. It is included under the general term, "'useful art.' An art may require one or more processes in "order to produce a certain result or manufacture. The term "'machine' includes every mechanical device or combination of "mechanical powers and devices to perform some function or to "produce a certain effect or result. But where the result or "effect is produced by chemical action, by the operation or ap- "plication of some element or power of nature, or of one sub- "stance to another, such modes, methods, or operations, are "called *processes.* A new process is usually the result of a dis- "covery—a machine of invention. The arts of tanning, dyeing, "making water-proof cloth, vulcanizing India rubber, smelting "ores, and numerous others, are usually carried on by processes "as distinguished from machines. One may discover a new and "useful improvement in the process of tanning, dyeing, &c., *irre- "spective of any particular form of machinery or mechanical "device.* And another may invent a labor-saving machine, by "which the operation or process may be performed, and each "may be entitled to his patent. As for instance: A has dis-

"covered that by exposing India rubber to a certain degree of "heat, in mixture or connection with certain metallic salts, he "can produce a valuable product or manufacture; he is entitled "to a patent for his discovery, *as a process or improvement in the "art irrespective of any machine or mechanical device.* B, on "the contrary, may invent a new furnace, or stove, or steam "apparatus, by which this process may be carried on with "much saving of labor and expense of fuel, and he will be en- "titled to a patent for his machine as an improvement in the "art. Yet A could not have a patent for a machine, nor B for "a process, but each would have a patent for the means or "method of producing a certain result or effect, and not for "the result or effect produced."

In Household Co. *vs.* Neilson, Webster's Patent Cases, 683, the Court says:

"It is quite true that a patent cannot be taken out solely for "an abstract philosophical principle; for instance, for any law "of nature, or any property of matter, apart from any mode "of turning it to account in the practical operations of manu- "facture or the business and arts and utilities of life. The "mere discovery of such a principle is not an invention, in the "patent law sense of the term. Stating such a principle in a "patent may be a promulgation of the principle, but it is no "application of the principle to any practical purpose; and "without that application of the principle to a practical object "and end, and without the application of it to human industry, "or to the purposes of human enjoyment, a person cannot in "the abstract appropriate a principle to himself. But a patent "will be good, though the subject of the patent consists in the "discovery of a great, general, and most comprehensive princi- "ple in science or law of nature, if that principle is by the "specification applied to any special purpose, so as thereby to "effectuate a practical result and benefit not previously attained. "The main merit, the most important part of the invention, "may consist in the conception of the original idea, in the dis- "covery of the principle in science, or of the law of nature, "stated in the patent, and little or no pains may have been "taken in working out the best manner and mode of applica- "tion of the principle to the purpose set forth in the patent.

"But still if the principle is stated to be applicable to any "special purpose, so as to produce any result previously un- "known, in the way and for the objects described, the patent

"is good. It is no longer an abstract principle. It comes to "be a principle turned to account, to a practical object, and "applied to a special result."

"It becomes, then, not an abstract principle, which means a "principle considered apart from any special purpose or practi- "cal operation, but the discoverer's statement of a principle for "a special purpose; that is, a practical invention, a mode of "carrying a principle into effect. * * This is a question of "law, and I must tell you distinctly that this generality of "claim—that is, for all modes of applying the principle to the "purpose specified, according to or within a general statement "of the object to be attained, is no objection whatever to the "patent. That the application or use of the agent for the pur- "pose specified may be carried out in a great variety of ways, "only shows the beauty and simplicity and comprehensiveness "of the invention."

"I state to you the law to be, that *you may obtain a patent* "*for a mode of carrying a principle into effect;* and if you "suggest and discover not only the principle, *but suggest and* "*invent how it may be applied to a practical result by mechan-* "*ical contrivance and apparatus, and show that you are aware* "*that no particular sort or modification of form of apparatus* "*is essential in order to obtain benefit from the principle, then* "*you may take your patent for the mode of carrying it into* "*effect, and are not under the necessity of describing and con-* "*fining yourself to one form of apparatus.* If that were "necessary, you see what would be the result. Why, that a "patent could hardly ever be obtained for any mode of carrying "a newly discovered principle into practical results, though "the most valuable of all discoveries, for the best form and "and shape and modification of apparatus cannot, in matters "of such vast range, and requiring observation on such a great "scale, be attained at once. Hence, you may generally claim "the mode of carrying the principle into effect by mechanical "contrivance, so that any sort apparatus, applied in the way "stated, will, more or less produce the benefit, and you are not "tied down to any form."

The point that Tilghman's claim involved a patent for a principle, was fully argued before Judges McLean and Leavitt in the suit of Tilghman against Werk, and the opinion of the

Court (Record, No. 340, p. 167) disposes of it in accordance with the authorities above cited.

The fact that Judge McLean, who agreed with Judge Leavitt in sustaining the validity of Tilghman's patent, was one of the majority of the Supreme Court which rejected Morse's 8th claim, gives additional weight to his decision on this point.

Tilghman having made the discovery that water when heated and retained in a liquid state by pressure in a close vessel to prevent its escaping as steam, possessed certain chemical powers with reference to fat, did not stop there.

He went on to find out how this principle might be made practically useful. The first thing was to discover by experiment how much water was necessary, and he announces in his patent that from one-third to one-half of the bulk of the fat will produce the result.

The next thing was to discover the degree of heat, and length of time, and he naturally sought to do it in the shortest time, and he found by experiment, and announces in his patent, that the higher the temperature the more powerful is the action, and that at the temperature of about 612° F., the action will take place in ten minutes.

In the case of Mowry *vs.* Whitney, the language used in the Whitney patent in describing his process was that "the temperature of the furnace or chamber, and its contents are gradually raised to a point a *little below* that at which *fusion commences* when, etc." 14 Wallace, p. 626.

This was the *only instruction* as to temperature given in that patent. The defendant relied on two points in opposition to that claim in the specification:

1. "That Whitney's patent is void, because that which is

described and claimed therein is not useful, inasmuch as it designates and provides for such a degree of reheating and none other (*'a little below that at which fusion commences'*), as will destroy the chilled periphery or tread—an essential feature to a car wheel."

2. "That Mowry's process does not infringe on Whitney's patent, because it is incredible (that in the Mowry process), any such degree of reheating is or could result as is contemplated in Whitney's patent." 14 Wallace, 636.

Upon these points this Court, per Mr. Justice Strong, says:

"The validity of the invention is next assailed for the reason "that the process described in it, and claimed, is denied to be "useful, because it would destroy the hardness of the rim, or "tread of the car wheel, known as the chill, and thus greatly "detract from the durability and usefulness of the wheels.

"It is undoubtedly true that a chilled periphery or tread is "essential to the usefulness of a car wheel. Indeed, the "evidence is, that whenever car wheels are spoken of, wheels "with chilled tread are meant, and any process which destroys "the chill must render them valueless for the purpose for "which they are needed.

"It is also true that the fusing point of cast-iron is in the neigh-"borhood of 2786 degrees of Fahrenheit, twelve or fifteen hundred "degrees above the point at which, according to the evidence, the "the chill of the tread of a car wheel would be destroyed. If, "therefore, the process patented to Whitney, requires, after the "removal of the wheel to the heated furnace or chamber, the "application of a degree of heat closely approximating the point "of fusion, it must be conceded that instead of being beneficial "it is positively hurtful. And this is what is contended by "the appellant. The objection seems to be aimed at the suffi-"ciency of the description of the patentee's invention, which it "is abundantly proved he practised successfully through many "years, rather than at its utility. Whitney conceived a pro-"cess and practised it. * * * * * * *

"Then the avowed purpose of the inventor has been accom-"plished. It would be most unreasonable to read the direc-"tions of the specification without reference to the object which

"they profess to have in view. The evidence is that the chill "is formed while the casting is in the mould, and that the hurt- "ful strains commence after the formation of the chill. Indeed "it is manifest there can be no strain until the chill is complete. "It must be, therefore, that all the heat which is needed to "relieve from the strain is that which suffices to raise the tem- "perature of the thin part, or plate, to the degree at which the "strain commenced—a lower temperature than that which "existed when the chill was formed. Hence an operator, in "following the directions of the specification, would be taught "by his practical knowledge that the instant all parts of the "wheel had been heated to that temperature no more heat "was needed."

"And we do not think it a fair construction of the patentee's "language to hold that it requires the heat to be raised in all "cases to a degree only a little below the point of fusion. He "does not attempt to give any more definite direction than that "all parts of the wheel must be raised to the same temperature, "suggesting in a parenthesis, ("say, a little below that at which "fusion commences.") He fixes a maximum. The heat must "not reach the point of fusion, and the prescribed minimum "is that degree where the heat of the different parts of the "wheel is equal. Within those limits the degree is left to the "judgment of the operator, and within those limits it is clear "from the evidence that the process may be applied without in- "jury to the chill. The proof is that it has been successfully "applied in the manufacture of a vast number of wheels, and "that failure has been very rare. 14 Wallace Rep., 644.

VALIDITY OF EXTENSION.

In the suit No. 340, in addition to the questions heretofore discussed, a question arose as to the validity of the extended patent.

It is alleged in appellant's answer, in case 340, that the extension is void because the Commissioner of Patents had no jurisdiction, for the reason that the notices of the application for an extension were not published in any papers published in any section of the country interested adversely to the extension

of said patent, and that, therefore, the proceedings were fraudulent and deceptive.

It is now well settled, that if an extension is regular on its face, no question of irregularity or fraud in the grant can be raised by an infringer in a suit against him for infringement.

Mowry *vs.* Whitney, 14, Wallace, 439.

Simpson *vs.* Railroad, 4 Howard Rep., 404.

Rubber Co. *vs.* Goodyear, 9 Wallace, 796.

Seymour *vs.* Osborn, 11 Wallace, 543.

Tilghman *vs.* Mitchell, 9 Blatchford, 19.

Tilghman *vs.* Werk, per Judge Emmons.

But this line of defence is not only bad in law, but is also entirely unfounded in fact, for the testimony shows that the publication of the notices of this application was made in precisely the same manner as in all the other applications made during the same year; that is, they were all ordered to be published in two Washington papers, and in one paper published at the residence of the patentee.

Appellee's witness (Matthewson, Record 340, p. 550,) testifies that he examined the files of the Washington National Intelligencer for 1867, and found notices of applications for extension of one hundred and one patents; that thirteen of these applicants were residents of the city of New York, seven of Philadelphia, three of Boston, three of Lowell, Massachusetts, five of Springfield, Mass., and two of Cleveland, Ohio. That in all these thirty-three cases the notices were ordered to be published in a newspaper published at the residence of the patentee, in addition to the publication in the two Washington papers.

He also proves that of the seven applications from residents

of Philadelphia, three were published in the Philadelphia Telegraph, two in the Philadelphia Inquirer, and two in the Philadelphia Universe; one of which last was the application of the complainant.

He says that he found the notice of complainant's application published seven times in the Washington Intelligencer, and three times each in the Washington Morning Chronicle and Evening Star.

Supposing it to have been published in the Washington Republican only the three times ordered, the whole number of publications in the Washington papers would amount to sixteen instead of six, and in four papers instead of two, as ordered by the Commissioner.

The same witness proves that the number of notices of extension published in the New York Scientific American in 1867 was but seventy-three.

As the whole number of such notices in that year was one hundred and one, it appears that appellant's counsel in their search for the notice of appellee's application, made the mistake of relying upon a very imperfect list.

The law directs the Commissioner "to cause to be published in one or more of the principal newspapers in the city of Washington, and in such other paper or papers as he may deem proper, published in the section of the country most interested adversely to the extension of the patent, a notice of such application, &c."

As any serious investigation as to what section of the country is most interested adversely to the extension of any particular patent would require the collection of a mass of statistics impossible to be obtained in the limited time allowed, the Patent

Office appears to have established the practice of selecting the residence of the patentee as the place of publication of the notice outside of Washington.

It is proved that there were large establishments in Philadelphia engaged in manufacturing and refining and consuming fat acids and glycerine, and necessarily interested in getting these articles as cheaply as possible, and, therefore, interested adversely to the evtension of the patent.

Appellant's witness, Grant, says (Record No. 340, p. 566), that he had a manufactory of fat acids in Philadelphia, and that he did not use appellee's process.

Appellee's witness, Bower, says (Record No. 340, p. 360), that he was then working in Philadelphia, one of the largest refineries of glycerine in the country.

It is well known, that in all large towns glycerine is extensively used in making printers' rollers, and in pharmacy and perfumery.

It is plain from the above,

1. That the usual routine was followed in the order of publication of this application.

2. That the actual publication far exceeded what was ordered.

3. That the place of residence of the patentee was largely interested against the extension.

4. That if appellant did not receive immediate notice, it was simply because he did not take the trouble of looking in the right place, or of inquiring at the Patent Office.

Discussion of Law on the Subject of Accounting in Equity.

In the application of the rule and mode of accounting there has been from time to time some difference of opinion and

some discussion. In one of the earlier cases, that of Livingston and Woodworth, and in the case of Hogg against Emerson, the doctrine was distinctly stated that the profits and savings are to be *what the defendant has made*, and not what the plaintiff *might have* made. The case of Livingston *vs.* Woodworth, 15 How., 546, goes no further than to say that in that case the Court would not allow the complainant to recover, on a showing *what he might have made*, if he had worked the thing. The question was what was the advantage to the defendant who did work it, and the Court drew the distinction there.

The case of McCormick *vs.* Seymour, 16 How., 480, which is often cited, was *an action at law*, and there it was held by the Court that the established license price, when there was one established, was a proper measure of the injury which the plaintiff would have suffered if he had made and sold his machines.

In the case of Rubber Co. *vs.* Goodyear, 9 Wallace, 788, this Court gave the plaintiff *all the profits* which the defendant had made. He had manufactured hard rubber in violation of the patent, and the accounting showed just what he had made. The Court proceeded on the doctrine that he had no right to work this process at all without the complainants' consent, and having done so, he must settle with them for what he had received.

In the case of Mowry *vs.* Whitney, in 11 Wallace Rep., 636, the patent was for an improvement in the mode of making car wheels. Mr. B. R. Curtis, in presenting that case to the Court below, took the same view of the case that had been taken before the Court in the India Rubber case (he having been counsel in both cases), to wit: that the defendant should pay to the

complainant *all the profits* he had made in the manufacture of the car wheels. The defendant assumed the burden of showing before the Master, and urged before the Court below, that there were other processes known and in use, and open to him to have been used, by which he might have made car wheels, which he could have sold at about the same price in the market, and that when he was stopped by the plaintiff's injunction, he did sell such car wheels; that he had sold them before, and could still have sold them. The view of Judge Curtis was sustained by the Judge at the circuit, holding that it was no answer for defendant to say he could have done this or that, and made such a profit; the answer is, *you did not do* it. You adopted plaintiff's plan, and you must pay him all the profits you have made. I have quoted in my brief exactly the position which Judge Curtis took in his argument before the Judge at the circuit. He said in that case:

"The Master was to ascertain and report what profits the "defendant had actually received by reason of his infringement "of complainant's patent, which profits may be something "greatly less or greatly more than actual damages at law, "according to circumstances; less, because the defendant may "have undersold the patentee in his own market, this course "resulting in small profit to the infringer and large loss to the "patentee; or, on the other hand, the infringer may have "sought a market which the patentee never would have sought, "and may have supplied and enlarged this market with great "enterprise and skill. Yet the rule is the same in one case as "the other, the infringer must account for his actual profits. "The patentee may not say the infringer might have derived "larger profits from a different course, nor can the infringer "say that the profits he actually realized from his infringement "of the patent might have been made, if he had not infringed "it.

But Mr. Justice Strong, in delivering the opinion of the Supreme Court on appeal therefrom, declared that the view of

the Circuit Judge was incorrect; that *it appeared by defendant's proof clearly that there were other processes which were* open to the defendant to use, and with which, if he had worked, he would have attained certain results; and that "the question to "be determined in this case is, *what advantage did the "defendant derive from using the complainant's invention, over "what he had in using other processes then open to the public "and adequate to enable him to obtain an equally beneficial "result. The fruits of that advantage are his profits.* They "are all the benefit he derived from the existence of the "Whitney invention. It is found that there were other "processes by which the inherent strain caused by unequal "cooling could be, and was prevented, counteracting which "strain was the sole object of the complainant's invention, and "a car wheel could be prepared for a similar service, valuable "in the market, and saleable at a price not less than was "obtained for those which the defendant manufactured. The "inquiry then is, what was the *advantage in cost, in skill "required,* in convenience of operation, *or market ability* in "bringing car wheels by Whitney's process from the condition "in which they are when taken hot from the moulds, to a "perfect state, *over bringing them to the same state by those "other processes,* and thus rendering them equally fit for the "same service, *that advantaye is the measure of profit." 14 Wallace, p. 651.*

I do not think that my learned brother, Keller, and myself, have ever differed materially as to the correctness of this view of law as stated in the Supreme Court, and even before it was announced we both agreed in argument before Judge Blatchford that such was the correct rule. My brother, Keller, in the case of Tilghman *vs.* Mitchell, thus lucidly sets forth the law:—

"The law is well settled that a Court of Equity can only "decree the saving which the defendant has realized by the "use of the plaintiff's invention. Such savings are frequently "termed damages or profits in the reported cases, but what is "meant are the savings due to the unlawful use of the plaintiff's "invention by the defendant. If the defendant has been im-"provident in the general management of his business, so that

"in the aggregate he has sustained losses instead of realizing "profits, the savings effected by the use of the plaintiff's inven- "tion will show how much less has been his loss than if he had "not used the plaintiff's invention, and that saving which has "been effected belongs to the plaintiff on the rule of equity, "which is to make full restitution."

Now, in reference to that statement made by brother Keller, Judge Blatchford, in this case (see Blatchford's Report, vol. 9, page 18,) says:

"On the hearing the defendant's counsel did not dispute "that if the savings of the lime, sulphuric acid, and fat was "due to the use of the plaintiff's process, the plaintiff was "entitled to the value of such saving as profits. That is un- "doubtedly a correct principle, as applicable to an accounting "for profits in cases of this description in equity."

Judge Blatchford says further in his opinion:—

"The plaintiff contends that the defendant, by manufacturing "fat acids and glycerine from fatty bodies, by the action of "water at a high temperature and pressure, according to the "plaintiff's process, has saved the quantities specified of lime, "sulphuric acid and fat, in working the specified quantities of "fat, and has made the specified additional profit from the "specified quantity of glycerine; that such saving and profit "are due to the use of the plaintiff's process, and that the de- "fendant must account for the same as profits under the inter- "locutory decree."

The distinction is drawn, that the established license price is not the measure of accounting in equity; where a man goes into a Court of law and asks for damages the established license price may become the measure of the injury done to the complainant; but where he goes into a Court of Equity and elects to follow the profits, he may get more and he may get less, but the measure is different. This has been declared numerous times. I refer the Court merely to its announcement by some judges at the Circuit whose opinions I know will be received with great respect here.

In the case of Hudson against Draper, the decision was rendered by Mr. Justice Clifford. (Judge Shepley sat with him, and concurred). It is reported in 4 Fisher, p. 256. They say, "different rules for the assessment of damages prevail in suits "in equity, from those which are recognized in actions at law; "but in other respects, the rights of the parties depend upon "the same construction."

So, again, the clear line is drawn between the measure of remuneration in equity and at law in the case of Cowing against Rumsey, in 4 Fisher, 278, where it is said by Judge Woodruff,

"A patentee whose rights are infringed, has his election of "remedies. He may treat the infringer, who illegally appro- "priates the invention to his own use, making profit thereby, "as his *trustee in respect to such profits, and* compel him to ac- "count *therefor in equity.* In such case the plaintiff may re- "cover *those profits, be they more or less;* and he can recover "no more, however *great the damages* may be which the illegal "interference has occasioned. If on an accounting it should "appear that the defendant used the invention so unskillfully "that he realized no profit, there could be no recovery. On "*the other hand*, the patentee may *sue at law for the damages* "which he has sustained; and those damages he is entitled to "recover, whether the defendant has made any profits or not. "In such an action it is precisely *what is lost to the plaintiff*, "and *not what the defendant has gained*, which is the legal "measure of the damages to be awarded. Under *this rule* it "may often be entirely proper to prove the profits of the ordi- "nary use of the invention, and the demand existing in the "market, evidenced by sales made, and so *as an element* of "consideration, show the profits realized by the defendant, in "order to furnish to the jury all proper materials for deter- "mining how much the plaintiff has lost. But I apprehend "that they are to answer the precise question. How much "loss has the plaintiff sustained by reason of the defendant's "infringement?"

At law the benefits or savings may be an *element* which may be regarded by the jury in determining the plaintiff's damages

while in equity they are not *an element* merely; but they are *the measure.**

Such has been the established rule in England in leading cases. The Court will find in the csae of Crossley *vs.* Beverly, the celebrated gas meter case, that the decree was made by Vice Chancellor Shadwell, as follows:

(Webster's Pat. Cases, 119.)

"That it be referred to the Master to take an account of "what profits have been received, and *what benefits derived* "from the use of such gas-meters as were made or manufac- "tured during the existence of such Letters Patent, and that "the defendants pay to the plaintiff what the said Master shall "certify to be due on taking such account, together with cost, "&c."

I wish also to cite the case of Sickles *vs.* Gloucester Manufacturing Co., a case in equity, reported in 2 Fisher, P. C., page 222, per Justice Grier. In that case the invention was a patent cut off, and a bill was filed asking an account of profits, which decree was opposed, because the patent had expired before the final hearing. The Court says: "As it appears in this case "that, in order to ascertain the extent of the plaintiff's dama- "ges, it might become necessary to have a discovery and "*account of profits from saving of fuel by using his invention,*

* By observing this distinction the language of Justice Nelson in the case of Suffolk Co. *vs.* Hayden, 3 Wallace, 320, agrees entirely with that of Judge Woodruff. That was a case at law, and in such a case speaking of a "*fair* "*measure of damages,*" the Court said:

"In order to get a fair measure of damages, or even an approximation to "it, general evidence must necessarily be resorted to, and what evidence could "be more appropriate and pertinent than that of the utility and advantage of "the invention over the old modes or devices that had been used for working "out similar results. With a knowledge of these benefits to the persons who "have used the invention, and the extent of the use by the infringer, a jury "will be in possession of material and controlling facts that may enable them "in the exercise of a sound judgment, to ascertain the damages, or in other "words," [not the equitable *profits* due the plaintiff] "the *loss to the patentee* "or owner, by the piracy, instead of the purchase, of the use of his invention."

" I see no good reason why the Court might not retain jurisdic-
" tion of the case for that purpose, even on the principle of
" the English cases."

In the case of Household Co. *v.* Neilson, reported in Webster's Patent Cases, p. 697, the judge says: "The *saving* spoken of,
" viz., £2 2s. per ton, is not contradicted. The answer that
" was put was this: be it that the manufacture was conducted
" at that *rate of saving*, still I have not made *profit on this*
" *whole concern*. That is no answer in point of law, and no evi-
" dence was tendered to show that the saving was overrated.
" Whether the saving comes to £3,400, as calculated, it is for
" you to say. I am bound to tell you in point of law that the
" pursuer is entitled to claim the *benefit arising* out of the
" *saving* made by his apparatus."

In a late case in the Circuit, Mr. Justice Clifford said:

United States Patent Office Official Gazette, 1872, page 98, Carew *vs.* Boston Elastic Company.

" Such gains and profits only, as were made by the respon-
" dent in the unlawful use of the invention could be recovered
" by the complainant in an equity suit prosecuted under the
" repealed patent act, as appears by several decisions. Livings-
" ton *vs.* Woodworth, 15 How., 558. Rubber Company *vs.*
" Goodyear, 9 Wall., 804. Different rules, however, are
" enacted in the new patent acts which provide that the com-
" plainant, when a decree is rendered in a suit in equity for
" infringement, shall be entitled to recover, in addition to the
" profits, to be accounted for by the respondent, the damages
" he has sustained thereby, and the further provision is, that
" the Court shall assess the same or cause the same to be as-
" sessed, in its discretion, and that the Court shall have the
" same discretionary power to increase the damages as that
" given by the act where the damages are found by a verdict
" in an action on the case. 16 Stat. at Large, 206."

" *Profits are to be accounted for* by the respondent in every
" such suit whenever a decretal order to that effect is rendered
" against *the respondent* for an infringement; and if it appears
" that the injuries which the complainant sustained by the in-
" fringement are greater than the gains and profits realized by
" the respondent in making and using the invention and vend-
" ing it to others to be used, as estimated and assessed, then the
" complainant is entitled to recover compensation for the excess

"of injuries sustained *beyond* the amount estimated and assessed "for the gains and profits received by the respondent. *Actual* "*damages for the injuries sustained* by the complainant *beyond* "*the amount estimated and allowed for the gains and profits* "made by the respondent must be assessed in the first instance." Pat. Off. Gazette 72, p. 98.

The above language would be unintelligible if "gains or profits" in equity and "damages" at law were one and the same, and had one and the same rule of measurement.

An ingenious argument is sought to be based upon the use of the word "damages" by Justice Strong, in connection with interest, in the opinion of this Court in Whitney vs. Mowry. This Court meant to say that although called *profits*, yet in so far as they are remunerative to plaintiffs, they may be classed as unliquidated damages, and therefore should not bear interest.

Mr. Justice Strong, by that expression, did not mean to sweep away all distinction between the measure of damages at law and the measure of so-called "profits" or gains in equity. It was the *entire savings* which the Court awarded in the Whitney case, and this Court merely took the *plaintiffs'* declaration of what the *entire savings* were, as a conclusive means of determining them. It is sometimes sought to establish some line of distinction between the case where a plaintiff is engaged in carrying on a business under his patent, and where he is merely the *owner* of the patent not carrying on business. If you look through the cases you will find there is not one in which any such distinction is recognized. There is no such point made in the decision in Goodyear *vs.* Rubber Company, and in the cases of Livingstone *vs.* Woodworth, 15 Howard, 546, and Dean *vs.* Mason, 20 Id. 198, the idea of involving in an equity decree the position of the plaintiff as a rival manufacturer, and the *injury as such that he suffered*, and the *attempt indirectly to*

make him whole as a manufacturer, was rejected by this Court. If the question, whether the plaintiff was himself a manufacturer working under the patent, cannot be regarded in the one case in favor of a plaintiff, it cannot be so regarded in another against a plaintiff. The law is clear that the only question in equity in a case like this is, what *saving* has the defendant realized by the use of the patent.

There can not be one measure of accountability in equity to a patentee where he himself works under the patent, and another where he does not in view of the above cases, where the Court declared that it was not the intention in equity to allow the plaintiff manufacturer what he *might* have made if he had not been interfered with by the defendant infringer.

As to the question of how far this Court will go in equity, in the matter of allowing interest on capital, etc., the Supreme Court in case of Rubber Co. *vs.* Goodyear, (9 Wallace, 804,) in reply to an exception made by the defendant that "he," (the Master,) "refused to allow manufacturers' profits and interest on the capital stock," say "this was correct." * * * * * "The rule is founded in reason and justice. It compensates one party and punishes the other. It makes the wrong *doer liable for actual* not possible gains. The controlling consideration is, that he should *not profit by his wrong.* A more favorable rule would offer a premium to dishonesty and invite aggression."

THE ACCOUNTING.

The Master was ordered to report the gains and profits of appellant from his use of the improvement patented to appellee.

I.

1. The improvement patented to appellee is the process for producing fat acids and glycerine from fats by the action of water at a high temperature and pressure.

OPINION OF JUDGE NELSON.

"It will be seen not only from the specification, but also from the claim, that the improvement patented to the complainant is the invention of a process for producing fat acids and glycerine from fatty or oily bodies,—*which process consists in the action of water upon these bodies at a high temperature and pressure, and which may be effected in any vessel adapted for such use.*"

II.

2. One item of the gain or profit by the use of appellee's process, is the saving of the quantity of lime and sulphuric acid formerly used in the old process to produce the fat acids and glycerine, which are now produced by the action of water at a high temperature and pressure in appellee's process.

Appellant's witness J. T. Verdin, Record 87, p. 201.

X Q. 48. How does the process carried on by defendant in the Wright & Fouché apparatus, differ from the process of Chevreul?

A. It differs in not using lime or other alkalies.

X Q 49. Is that an important difference, and if so, why is it an important difference?

A. It is, because it dispenses with the use of chemicals, consequently a saving of cost and expense.

Appellant's partner J. Verdin, Rec. 87, p. 228.

X Q. 30. What saving is effected by this process over the old process, that induced you pay this price?

A. About ¾ of a cent per pound.

Same witness—Rec. 87, p. 344.

To decompose 8000 pounds neutral fat with the use of lime the cost would be

* * * * * * * *

5 barrels lime, 1120 lbs. at $2 per barrel, . .	$10 00
Sulphuric acid, 2240 lbs. at 3 cents, . . .	67 20

* * * * * * * *

Appellant's witness, N. Ropes, Rec. 87, p. 109.

X Q 16. How many pounds of lime and how many of sulphuric acid did you save by Tilghman's process on each hundred pounds of stock worked by you, as compared with the old process used prior to the introduction of Mr. Tilghman's process?

A. Well, we saved about 12½ pounds of lime, and 25 pounds of sulphuric acid on the hundred pounds of stock.

X Q 17. In your opinion, is it or not owing to the decomposing power of highly heated water that this saving is due?

A. Yes sir, I think so.

Appellant's witness, N. Ropes, Jr., Rec. 87, p. 113.

X Q 1. You say that in using Tilghman's process you generally employed one-half per cent. of lime; how much saving of lime and acid was effected by this process per 100 pounds of fat, as used by you, as compared with the old process as used prior to the introduction of Tilghman's process?

A. The saving would be 10½ to 12½ pounds of lime to 100 pounds of fat, and twice that quantity of vitriol.

X Q. 2. Was not this saving by Tilghman's process due to the chemical action of highly heated water under pressure on the fat?

A. It was.

Appellee's witness, C. T. Jones, Record No. 87, p. 17.

Q. 4. State what process you now use, and what are its advantages: and also whether you practice the said process by a license from the complainant, and have paid and are to continue to pay him for its use?

A. I use the process patented to Mr. Tilghman, plaintiff in this case, the advantages of which, over all other processes

known to me are, that it enables me to produce fat acids without the use of lime or sulphuric acid.

I do practice this process by a license from the complainant, and have paid and am to continue to pay him for its use.

III.

This saving of chemicals arises from the use of the *process*, and not from the use of any particular form of apparatus. This saving is the same in whatever form of apparatus the process may be conducted.

Whenever fat acids and glycerine are produced from fats by the use of water at a high temperature and pressure, instead of by the use of chemicals, it is evident that the chemicals are saved.

Appellant's witness, C. T. Jones, Record No. 87, p. 328.

X Q. 14. So far as the saving of lime and sulphuric acid is concerned, could not the same economy be attained in such an apparatus as in that used by defendant?

A. Yes.

X Q. 14. Is the saving of lime and sulphuric acid at all affected by the particular method of mixing together the fat and water which may be used?

A. I cannot consider that it is.

Appellee's witness, J. C. Booth, Record 87, p. 258.

Q. 27. Will or will not this chemical saving be realized in any form of apparatus whatever, in which fats are decomposed into fat acids and glycerine by the action of water at a high temperature and pressure? (Objected to.)

A. It will.

IV.

Appellant's partner admits that appellee's peculiar apparatus and circulation by themselves, and without the use of appellee's high temperature and pressure, would not produce any

appreciable fat acids and glycerine. Consequently they would not save the chemicals.

Florence Verdin, Record 87, p. 380.

Q 24. If the upper vessel of the Wright & Fouché apparatus were left open, so as to prevent any steam pressure therein, would or would not the circulation of the water through the fat be produced therein the same as if worked at the usual pressure?

A. The circulation would be the same, but the water would evaporate, and the fat would remain in the boiler without water.

Q 25. Supposing the proper quantity of boiling water to be constantly supplied to make up for this loss by evaporation, and that the circulation is kept up during ten hours without any pressure, what would be the result as to the decomposition of the fat into fat acids and glycerine?

A. The result would be that the fat would have changed slightly, but there could not be found any traces of glycerine.

Q 26. What per centage of fat acids would there be found in the fat?

A. I have never tested it; I could only judge by the appearance of the fat that the fat has changed.

V.

Appellant's invention of peculiar machinery or apparatus to carry out the process gives him no right to use the process, and consequently no right to the saving of chemicals resulting from the use of the process.

OPINION OF THE COURT—p. 5.

"The question here is, does the defendant, whatever may be "his vessel or machinery, manufacture, or produce fat acids "and glycerine from fatty bodies by the action of water at a "high temperature and pressure, according to the process as "explained by the plaintiff in his specification? We are satis-"fied that he does, and hence has infringed his patent. Our "conclusion is, that the complainant is entitled to a decree for "an injunction and profits."

VI.

Appellant's partner and foreman prove that 14 pounds lime and 28 pounds of sulphuric acid were used by him in the old process.

This lime and acid were saved to him by his use of complainant's process, and are to be accounted for at their market price at the time when saved.

Appellant's witness and foreman, J. T. Verdin,—Record No. 87, p. 128.

X Q. 149. How many pounds of lime were used to 100 pounds of fat?

A. About 14 pounds of lime.

X Q. 150. How many pounds of sulphuric acid were subsequently used to the same quantity of fat?

A. About two pounds of acid used to every pound of fat.

Appellant's witness and partner, Florence Verdin,—Record No. 87, p. 344.

To decompose 8000 pounds neutral fat with the use of lime, the cost would be * * * * *

5 barrels lime, 1120 (14 per cent.), at $2 per barrel,	$10.00
Sulphuric acid, 2240 lbs (28 per cent.), at 3 cents,	67.20

VII.

By the use of the lime and acid in defendant's old process, a large mass of refuse sulphate of lime was formed, which held entangled a considerable quantity of fat.

Much labor was expended in washing out the fat from this refuse sulphate of lime, but it still retained about 2 per cent. of all the fat employed, which could not be separated and was thrown away with the refuse and lost.

By the use of appellee's process of employing highly heated water instead of lime and acid, defendant avoided the formation

of this refuse sulphate of lime, and consequently saved the labor of washing and the loss of 2 per cent. of the fat.

This saving of two per cent. of the fat should be accounted for at its price at the time when saved.

Appellant's witness and partner Florence Verdin. Record 87, p. 344.

"Add 2 per cent. for the loss of material, $17.60."

And same witness. Record 87, p. 381.

X Q. 27. In your estimate of the cost of the lime saponification process in your testimony of December 10th, 1867, p. 115, you put down a loss of 2 per cent. of material; please explain what this loss is, and how it occurs?

A. The loss is fatty acids. I suppose it is carried away with the sulphate of lime.

VIII.

The glycerine produced by the old process was so weak and impure that it was practically valueless, and was almost universally thrown away.

The whole quantity ever utilized by appellant in ten years, prior to his adoption of appellee's process, was 15,158 pounds, which he sold for $4,570 55. Whereas, since his use of appellee's process, in six years he has sold 708,733 pounds glycerine for $98,774.

During the six years of his employment of appellee's process, appellant's sale of glycerine were, therefore, forty-six times as much in quantity and twenty-one times as much in value as in the ten years of his use of the old process.

This increase of value is evidently due to the superior strength and purity of the glycerine produced by appellee's process.

It is in proof that appellee's licensees sell their crude glycer-

ine at a price which amounts to one-fifth of a cent for the glycerine obtained from each pound of fat worked.

Appellant's profits from the use of appellee's process as a source of glycerine, have been one-fifth of a cent per pound on the 10,337,147 pounds of fat which he has worked during the six years, and for this he should account.

R. G. Mitchell, Appellant,—Record No. 87, p. 253.

"There was no demand or sale for unpurified glycerine, such "as we produced six years previous to the introduction of the "Wright & Fouché apparatus into our works."

Same witness,—Record No. 87, p. 381.

1. State if you know the price obtained by complainant's licensees in Cincinnati, for the glycerine made and sold by them, and the sources from which you obtain your knowledge thereof?

A. Messrs. Jones, Shillito & Werk, all testify in this case that they sell it for 25 cents per barrel of 40 gallons for one degree of density.

Same witness,—Rec. 87, p. 383.

XQ. 11. What is the average density of the glycerine solution as it comes from the Wright & Fouché apparatus?

A. About 5 degrees Beaumé.

Appellant's witness, J. T. Verdin,—Rec. 87, p. 129.

XQ. 160. In your present process what quantity of fat and of water are placed in each apparatus, and what is the density of the solution of glycerine obtained?

A. We use a quantity of water equal to two-thirds the bulk of the fat. The solution of glycerine is from 3 to 4 degrees of Beaumé's hydrometer.

We use about 800 pounds water, and from 1100 to 1200 pounds of fat in each apparatus.

Taking the average density of appellant's glycerine solution to be 4 degrees Beaumé, a barrel of 40 gallons or 320 pounds would sell for $1.00, and would be produced from 1½ times that quantity, or 480 pounds of fat.

IX.

The question may arise how we are to distinguish between the profits of appellant, which have resulted from the use of his own peculiar apparatus, and the profits which result from his use of appellee's *process* as distinct from any particular form of apparatus.

Note

Interest is claimed on the amounts saved in each working year, ending July 1.

The Supreme Court in the case of Mowry *vs.* Whitney, Wallace, p. stated that under the circumstances of that case they would not allow interest. In this case it is submitted there is strong ground for allowing interest from the fact that the appellee was fully notified and warned in advance not to infringe. See letter ante page —

The bill was filed June 2, 1862, and he infringed *pendente lite.* In any event interest should be allowed from the date of the entering of the interlocutory decree, viz.: December 1, 1864, because the Court, on the application of appellant, withheld the perpetual injunction, and accepted a bond from the appellee to account for the profits to date of final decree. The appellant thus voluntarily became the factor of the appellee, and had full knowledge of his relation while he continued to infringe. See Stipulation, Record 87, p. 417, and interlocutory decree, Record 87, p. 411.*

* As to the interest, the Court said, in Mowry *vs* Whitney, 14 Wallace, 653, "interest is not *generally* allowable upon unliquidated damages. We will not "say that in no possible case can interest be allowed. It is enough that the "*case in hand* does not justify such an allowance." The present case, if any,

Defendant is in the position of a wrong doer, who has appropriated the property of another.

When that property is reclaimed and identified, and adjudged to be restored to the owner, defendant alleges that he has improved it, or mixed and confused some of his own property with it.

In that case he is bound to show distinctly and affirmatively, the precise nature and extent of his own property or improvement, so mixed and confused by his own wrongful act. The burthen of proof is on him, and every presumption is against him.

"Omnio præsumunter in odium spoliatoris."

Defendant has not produced any evidence to show how much of his profit came from his peculiar apparatus as distinguished from the process.

But it is evident that the one item of the saving of chemicals which is proved to be realized in all other forms of apparatus in which the process is worked, as well as in defendant's peculiar apparatus, cannot be attributed to defendant's peculiar apparatus.

Defendant's partner (F. Verdin, p. 80,) admits that defendant's peculiar apparatus and circulation, without the use of complainant's high temperature and pressure, would not produce any appreciable fat acids and glycerine. Consequently they would not save the chemicals.

This saving of chemicals (and the saving of fat and glycerine

should furnish an exception, for the defendant claimed to act under a patent which avowedly claimed only a mode of agitation. He was duly notified of his proposed infringement in advance, and he deliberately went on after a decree on final hearing under an *agreement to account.*

which necessarily follow the disuse of chemicals), *and this alone* is what complainant claims.

All doubt or question as to how much more profit, over and above the saving of chemicals, defendant has made by the use of his peculiar apparatus, is thus entirely avoided. He is left in undisturbed possession of it all, be it much or little.

RECAPITULATION.

Points for Complainant.

The Master is called upon by complainant to report the following facts as proved:

1. That appellant has made a profit by the saving of the quantity of lime and sulphuric acid, formerly used by him in his old process, to produce the fat acids and glycerine which he now produces, without using lime or sulphuric acid, by the action of water at a high temperature and pressure.

A. That the quantity of lime and sulphuric acid thus saved by defendant is 13½ pounds lime and 27 pounds sulphuric acid on each 100 pounds fat decomposed into fat acids by the action of water at high temperature and pressure.

2. Appellant has made a profit by the saving of the quantity of fat formerly lost and thrown away with the refuse sulphate of lime produced in his old process, but which fat is no longer lost since his use of appellee's process, in which no refuse sulphate of lime is produced or thrown away.

A. That the quantity of fat thus saved by appellant is 2 pounds on each 100 pounds of fat decomposed into fat acids by the action of water at a high temperature and pressure.

3. Appellant has made a profit by the increased strength, purity and value of the glycerine obtained by his use of

appellant's process, as compared with that obtained by his former process.

A. That this increase of value of the glycerine amounts to one-fifth of a cent on each pound of fat decomposed into fat acids and glycerine by the action of water at a high temperature and pressure.

4. The Master was called upon to report the specific quantity of lime, sulphuric acid, and fat saved by appellant on each 100 lbs. fat which he has decomposed into fat acids and glycerine by the action of water at a high temperature and pressure.

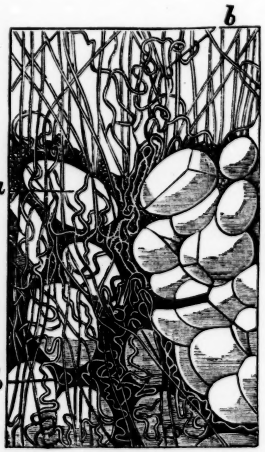
ARGUMENT FOR APPELLANT IN REPLY.

PRIOR STATE OF ART.

I.—*Decomposition of fat by soap making.*

Fat exists in nature in the form of minute globules disseminated among the tissues of the animals and vegetables producing it. To separate it in a commercial form heat and pressure are used for vegetable tissues as in linseed oil mills.

The fat cells always present a nearly spherical form (as shown at *a a* in the figure), their intervals are traversed by a minute network of blood-vessels from which they derive their secretion — *b b* are fibres of areolar tissue.



Fatty tissue of animals of which the microscopic appearance is given in the cut, cannot be broken up by pressure; but when heated so as to expel all its water, the animal tissue contracts and shrivels up at the same time that the fat globules are much expanded so that the cells burst and the fat flows out in a liquid mass. This process is called "rendering" and the shriveled animal tissue left after the fat is removed is called the "cracklings;" this process produces very offensive smell and wastes considerable fat in the cracklings; when fat is boiled with water, a portion of the animal tissue is dissolved and a corresponding portion of fat is "rendered," but it is too slow and incomplete a process for practice.

In 1823, Appert patented, in France, the process of rendering fat in a closed boiler with water, so that its heat is raised to 266° F., in place of 212°, as in open vessels. This increase of temperature so increases the solvent power of the water for the animal tissue that it is entirely dissolved and all fat obtained. This process of Appert's has been extensively used, and has been repeated over and over again in various forms for rendering and purifying fats and oils, and will be frequently presented in the exhibits of this case.

Fats obtained from various sources differed much in hardness and fusibility, and each variety was formerly supposed to be an entirely different article. About 1816, Braconnot, a French chemist, discovered that they were mere mechanical mixtures, in various proportions of fats entirely solid and hard, now called stearine, with an entirely fluid fat or oil. He found that simple pressure very slowly applied, separated the fluid part and the remainder made hard candles; but the process was difficult and imperfect.

Chevreul, in 1825, discovered that fats were compounds of a substance called glycerine, with a fatty body, having slight acid characters called fatty-acids; that when fats were deprived of this glycerine the fatty acids could be rapidly and perfectly pressed and made the best possible material for candles, and he patented a process of obtaining these fatty acids. Record 87, p. 244.

His process consisted of two distinct stages:

1. The manufacture of the fat into *soap*, by the use of lime or other alkali—14 pound of lime were used to 100 pounds of fat.

2. The decomposition of the soap so produced into fat acid by the use of two pounds of sulphuric acid to each pound of lime.

Soap had always previously been made by boiling the fat and solution of alkali together, and he suggested that this production of *soap* could be expedited by boiling the fat and the solution of alkali together *under pressure*. He made no suggestion or hint that *water alone*, heated and under pressure, would of itself decompose neutral fat into fat acid and glycerine.

That the invention of Chevreul is as above set forth, and is different from Tilghman's, is proved.

1. By admissions of appellant's witnesses.

Appellant's witness, Dr. Smith. Record, p.

Q. The process applied to manufactural chemistry, and known under the general term of saponification of the fats, have been: *First*, by decomposition of the fats with alkalies, alkaline earths, and other bases in conjunction with water and heat, either in open vessels or under pressure. This was first applied in 1825, by Chevreul and Gay Lussac, and has been subjected to various modifications since.

Same witness. Record, p.

Q 119. From the time of Gay Lussac and Chevreul's patent up to 1854, has it not been generally stated in chemical and technical works, that the direct product of the lime-saponification process, was a lime-soap, meaning thereby a neutral lime-soap, or with an excess of lime?

A. It has been so understood.

Appellant's witness, Vander Weyde. Record 87, p. 162.

Q 78. Did Chevreul make free fat acids or a neutral soap by this saponification?

A. He made a soap first, in order to convert it afterwards into free fat acids.

2. Proved by testimony of appellee's witnesses:

Prof. J. C. Booth. Record 87, p. 36.

"Exhibit 18," from "Certificates of Inventions," vol. 41, pages 392 and 393, January 5th, 1825, contains a part of the

patent granted to Gay Lussac & Chevreul, for the application of stearic and margaric acids to illuminating purposes, in which they state the first process always to be making a soap of the fat by acting on it with an alkali, potassa, or soda, and subsequently separating the acid. They further state that the operation of soap making may be performed at ordinary temperatures and pressures, but that the operation of making soap at a more elevated temperature, with a pressure of several atmospheres, presents greater advantages. In complainant's "Exhibit AA," claiming to be part of the passage quoted in "Exhibit 18," the methods of decomposing the soap so as to get fat acids, and of separating the fluid acid from the solid acid, are stated. Plaintiff's process has nothing whatever to do with the making of soap from fats, but makes fat acids and glycerine from fats by the direct action of water.

Prof. F. A. Genth, Q 9. Record 87, p. 73.

III. Chevreul & Gay-Lussac.	III. Tilghman.
1. Produces a neutral soap by using enough alkali to saturate all the fatty acids contained in the fat.	1. Produces no soap.
2. Produces no free fatty acids directly.	2. Simultaneously produces free fatty acids and a solution of glycerine, by the direct action of highly heated water upon fat.
3. Produces soap, both at ordinary and elevated pressure.	3. Elevated pressure indispensable.

Prof. Booth. Record 340, p. 223.

Appellant's Exhibits.	Appellee's Process.
Roret (*Exhs.* 4 *and* 5), *Gay Lussac & Chevreul* (*Exh.* 6), *Rudley & Meyer* (*Exh.* 10).	
Make neutral lime soap either in open or closed vessels.	Produces no soap.
Do not make free fat acid.	Makes free fat acid.
Lime is the chemical agent which decomposes the fat.	Highly heated water is the chemical agent which decomposes the fat.

Prof. Rogers. Record 340, p. 291.

Q 18. Examine defendants' Exhibit No. 6 (Chevreul's patent), and state whether it contains any evidence of a prior knowledge or use of the process patented to complainant.

A. It contains no such evidence; it refers exclusively to the making of *soaps* either in open or close vessels.

II.—DECOMPOSITION BY SULPHURIC ACID DISTILLATION.

The sulphuric acid distillation process was invented and used for producing *fat acid only*, and not glycerine: the glycerine being *destroyed* by the process. This process differed from Tilghman's.

1. In the result produced—fat acid only, while Tilghman's produced simultaneously both fat acid and glycerine.

2. It required sulphuric acid to decompose the fat into fat acid.

3. It did not depend for its efficiency on the use of highly heated water under pressure.

4. It was a process of distillation.

Def. Witness, Dr. Smith, Def. Test. p. 81.

Fourthly, by heating the fats with sulphuric acids (containing two equivalents of water), and by subsequent distillation, the fat acids are obtained and the glycerine destroyed. It has been carried on successfully and extensively since about 1846.

Journal of Society of Arts, London, 1855. Paper by G. F. Wilson, Vol. 3, p. 729. (Complainant's Testimony, Tilghman vs. *Mitchell, p. 125.)*

By our first improvement in separating the fat acids from neutral fats, the glycerine was decomposed by the direct action of concentrated sulphuric acid at a high temperature, and all that remained of it was a charred precipitate.

Verdin, Sr., Rec. 87, p. 143.

Q. 9. What is the method by distillation?

A. We saponify the fate first with sulphuric acid, and wash the sulphuric acid out afterward with hot water. That water takes out the glycerine and the sulphuric acid, and then from there take it and put it in the still, and distill it over by fire and steam, and then condense it, and let it off as fatty acids.

Appell.' witness, John H. Smith, Rec. 87, p. 219.

Q. 2. Before the distillation is commenced in that process, state whether the glycerine contained in the fat is previously destroyed or removed, and by what means?

A. We suppose it is destroyed by acidification of the fats by sulphuric acid.

Q. 3. State whether this is before the distilling part of the process commences?

A. It is.

The above two processes, viz.: Chevreul's lime soap process, and the sulphuric acid distillation process, were the only processes practically used down to the time of Tilghman's invention, as proved by defendant's witness.

Wayne, Defendant's Testimony, p. 186.

Q. 156. Were any processes for manufacturing fat acids practically worked as a manufacturing operation prior to 1854, except the lime saponification process, and the process of sulphuric acid combined with distillation?

A. Not that I know of.

Q. 157. In the process by sulphuric acid combined with distillation, was the glycerine destroyed?

A. It was.

Appellant's foreman, Verdin, Jr., Rec. 87, p. 212.

XQ. 168. From all your reading and your experience in factories, can you say that any mode of decomposing fats was practically employed in a stearine candle factory prior to the date of Mr. Tilghman's patent, January, 1854, except the process of lime saponification or sulphuric acid distillation process?

A. I can not.

III.—Attemted Decomposition by Steam.

It was from time to time attempted, prior to Tilghman, to decompose neutral fat into fat acid by distillation in a current of steam, but

1. It was an unsuccessful and abandoned experiment, and never came into use.

2. Even if it had been successful it differed in every way from the process of Tilghman, thus:

a. It differed in not producing glycerine as a result.

b. It differed in not depending upon, or even allowing of, the presence of highly heated *water* under pressure.

c. It was a process depending on vaporization and subsequent condensation of the fat.

d. The apparatus absolutely *necessary* for the distillation process was such as to render the execution of the hot water process of Tilghman in the same utterly *impossible.*

1. The steam distillation process was an unsuccessful and abandoned experiment.

The persons chiefly relied upon by appellant as using the steam distillation process were G. F. Wilson and Scharling and Dubrunfaut.

Appellant's Witness, Wayne, Record No. 340, p. 468.

Q. 108. Was the process of Scharling at the heat mentioned by him (320° Fahr.,) practically employed for manufacturing fat acids, prior to 1854, as far as you know?
A. I cannot say that it was.

Defendant's partner and witness, Verdin, Sr., Record 87, p. 167.

X. 56. Do you know of any factory where fat acids and solution of glycerine were manufactured directly by distilling neutral fat in a current of steam, prior to January 9, 1854?
A. No.

Defendant's foreman and witness Verdin Jr., Record 87, p. 202.

X. 60. Did you know of Scharling's process ever being tried or attempted to be tried by any one prior to April, 1864?
A. Not as to my personal knowledge.

Scharling tried it and says it would not be advantageous to obtain margaric acid (fat acid) from tallow for practical use; he says:

Appellant's Exhibit 10, Rec. No. 87, p. 237.

"By treating tallow with super-heated vapors of water, a "hard crystalline mass was obtained, which consisted princi- "pally of margaric acid. But the decomposition of the tallow "in this manner *took place so slowly, that it will not be advanta- "geous to obtain the margaric acid for practical use in this "manner.*"

And defendant's principal witness, Verdin, Jr., admits that the statement of Scharling shows it was an unsuccessful experiment, and would of itself induce a person to avoid this process.

Record 87, p. 211.

X. 157. Would not a person reading his paper be induced to conclude from the paper itself that he had better try some other mode of decomposing tallow than by using Scharling's own process?
A. I rather think yes.

Prof. Robert E. Rogers, Rec. 87, p. 63.

My conviction is, that in the special cases referred to by Scharling of results, the steam or vapor of water, did little if anything in setting free the fat acids, but simply aided in the volatilization of the fat acids already present in the so-called neutral fats?

Direct examination resumed, Rec. 87, p. 63.

Q. 25. Does Scharling anywhere say that he obtained glycerine as well as fat acids by his distilling experiments; state also, where the glycerine would have been found, if he had produced any in said experiments?

A. He nowhere states that he produced glycerine in his experiment. Had he produced glycerine, it would have been found carried over with the vapor of water.

Q. 26. Would not any chemist making the chemical examination of the over distilled water, which he states he made in search of sebacic acid, have been certain to have found said glycerine, as a residue in the process, if any had existed there?

A. Glycerine is so marked in its properties, and so readily detected, that I cannot conceive it could fail to be recognized and spoken of by any one professing to be a chemist, should it actually exist in the over distilled water had it been present in it, in the case of Scharling's experiment. The omission to mention it on his part, I conceive clear evidence of its absence altogether.

G. F. Wilson states that the direct distillation of fats destroys or decomposes the glycerine, and that it was preferable to abstract or destroy the glycerine before attempting to distil. Extract from patent of Gwynne & Wilson, 1843, Appellant's Ex. 1000, Rec. No. 87, p. 85.

"In the course of a series of experiments in which we have been engaged for some time past, relative to the distillation of fatty and oily matters, we have particularly observed that fats and oils in their natural state are not well adapted for distillation, owing, as it appears, to the presence of the ingredient called "glycerine," and that although fats and oils can be distilled in their natural state, and the distillation itself destroys or decomposes the "glycerine," it is a preferable mode of operation to abstract, destroy, or decompose the "glycerine" in the first instance, and afterwards to submit the fatty or oily matters to distillation in the acidified or modified state produced by such action."

The steam distillation process did not depend upon or even allow the presence of highly heated water under pressure; the steam distillation apparatus and the apparatus for using highly heated water under pressure are of a directly opposite and incompatible character.

Appellant's Witness, Dr. Smith, Record No. 340, p. 465.

Q. 194. In the process of Dubrunfraut, (Defts. Ex. No. 8,) or in that of Scharling, (Defts. Ex, No. 12,) or in that of Payen, (Defts. Ex. No. 8,) is any liquid water, at a high temperature and pressure, present, mixed with the fat, during the operation?

A. There would appear to be no water present in a liquid form.

Q. 195. Could the processes of defendants or of complainant be operated in the distillatory apparatus of Dubrunfaut, or of Scharling, or of Payen, referred to in cross-question 194, or could either of the three last named processes be oporated in the apparatus of defendants or complainant?

A. *The processes of both the complainant and defendants are different from the above,* and could not be performed in the above apparatus, for both the complainant and defendants call for closed digesters, while the stills of Dubrunfaut and Scharling have open communication with the atmosphere.

Appellant's Witness, Wayne, Record No. 340, p. 445.

Q. 84. In the process of Scharling, (Defts. Ex. 12,) is all the fat acid mentioned as having been produced by him, described as having been distilled and found in the condenser?

A. It is.

Q. 85. In said experiment of Scharling, is any liquid water described as having been mixed with the fat while the fat was at the temperature of 160° C. (320° Fahr.)?

A. There is not.

Q. 86. In said experiment was any pressure above that of the atmosphere applied to the still?

A. No.

Appellee's Witness, Prof. Booth, Record No. 340, p. 214.

Q. 92. State whether the description of Dubrunfaut's process in Exhibit 8 contains any evidence of a prior knowledge or use of complainant's process, and explain wherein it resembles or differs from complainant's process.

A. It contains no such evidence, since it makes no mention of the manufacture of fat acid by the action of highly heated water. Dubrunfaut decomposes fats by a current of steam at a light temperature; Plaintiff decomposes fats by a highly heated water. Dubrunfaut decomposes fats at ordinary pressure; the plaintiff decomposes fat at a high pressure. Dubrunfaut

employs an open vessel; plaintiff employs a closed vessel. Dubrunfaut employs steam, or the vapor of water; plaintiff employs liquid water.

Prof. Booth, Record No. 340, p. 220.

Q. 124. Explain wherein Scharling's process, as described in Exhibit 12, resembles or differs from complainant's process.

A. In Scharling's process oils or fats are heated in an open vessel or still, and superheated steam passed through them. The fat acids are thus distilled over, and condensed in a cold receiver.

Scharling's process is essentially the same as Dubrunfaut's in defendant's Exhibit 8; it is merely carried on at a lower temperature and less rapidly, so that for tallow it is stated to be too slow for practical use. Scharling's process resembles complainant's only in one point, that they both produce fat acids. Scharling distils the fat acids; plaintiff does not distil them. Scharling's process requires open vessels; plaintiff's process requires close vessels. Scharling's process is performed without pressure; plaintiff's process requires pressure. In Scharling's process no liquid water is or can possibly be mixed with the heated fat; in plaintiff's process liquid water must necessarily be mixed with the heated fat. In plaintiff's process the glycerine is found dissolved in the water. In Scharling's process no mention is made of the glycerine.

Defendant's witness, Verdin, Jr., Record 87, p. 200.

X. 28. In Scharling's process, why is there an absence of pressure?

A. Because the outlet of the vessel is larger than the pipe conveying the steam into it.

X. 30. Does not every process of distillation require the absence of pressure?

A. Yes, sir; the distillation process requires the absence of pressure.

Verdin, Jr., Record 87, p. 142.

X. 282. Can process of manufacturing fatty acids by the process of distillation in a current of steam be practically carried out, either in the apparatus described in complainant's patent, or in the apparatus used in defendant's factory?

A. No sir.

X. 285. State whether the process of decomposing fats into fatty acids and solution of glycerine by the action of water at high temperature and corresponding pressure, as effected in the apparatus of both plaintiff and defendant, can be practically carried out in the apparatus made use of for distilling fats into fatty acids by the action of a current of steam.

A. They can not.

Prof. Wolcott Gibbs, Record 87, p. 12.

Q. 14. (Objected to.) Could the plaintiff's process be worked in the distillation apparatus described in Exhibit 4?

And could this distillation process be worked in plaintiff's apparatus?

A. I answer no, to both branches of this question.

The state not only of the art, but even of scientific knowledge on the subject of attempted steam distillation of neutral fats, is fully shown by the report of the

EXPOSITION UNIVERSELLE DE 1855.

Jury Report,

p. 495, 496, immediately preceding defendant's exhibit, Record No. 340, p. 523.

Aqueous Saponification combined with Distillation.

"The researches of Chevreul having shown that the saponi-
" fication of the fatty bodies is accomplished by the fixation of
" the elements of water by the fat acids and glycerine
" which compose them, it was very natural to search for means
" to effect this reaction by the intervention of water only, and
" to combine it with distillation. In the patent of June 9,
" 1825, granted to Moses Poole, we see the distillation of the
" neutral fats, under the influence of heat and water, proposed
" for the first time. But it must be remarked that the intro-
" duction of steam into the still, had for its object 'to facilitate
" the evaporation.' As we have previously remarked *it was*
" *optional.*"

" All the chemists who have attempted to carry out the opera-
" tions described in this patent, have acknowledged its correct-
" ness; but all have also found that the production of fat acids

" is accompanied by acroline, the irritating properties of which,
" upon the eyes, are such that no one can resist it."

" Gay Lussac, himself, was so convinced that in this distil-
" lation it was not possible to prevent the decomposition of the
" glycerine, and the production of acroline, that in 1828, in
" his course of lectures he declared that the distillation of
" tallow ' could not be useful in the arts,' (note Cours de Chimie
" de M. Gay Lussac, tome 11, 29 lecon (28 Juillet, 1838), p. 12.)"

" M. Dubrunfant resumed this subect In his patent which
" we have already quoted from asto the distillation of fat acids,
" he states as follows: * * * *

(Here follows the extract from Dubrunfant's French patent, which is translated and printed. Record, p. 233, 234.

" The manufacturers who have tried to put in practice these
" directions have been obliged to abandon this method of sapon-
" ification and distillation. In fact they cannot thus avoid ths
" production of acroline, which greatly incommodes the work-
" men.

" It was reserved for M. G. Wilson, of whom we have already
" spoken, in relation to the sulphuric saponification combined
" with distillation, to resolve this *great* and *difficult* problem.
" We say difficult; it has appeared so, to such a degree, that
" before the jury had obtained precise and indisputable inform-
" ation, the announbement of the solution of the problem had
" been received with *doubt*, not to say *entire disbelief*.

" But at present it is no longer possible to doubt. In fact,
" M. Wilson has succeeded, by the aid of heat and water to set
" free simultaneously the fat acids and glycerine which compose
" palm oil, and to cause, at the same time, the distillation of
" these acids and the glycerine, so as to obtain all these pro-
" ducts in a state of chemical purity.

" On the 30th August, 1855, our learned colleague, M. War-
" ren de la Rue, visited the factory at Battersea, near London,
" and saw in full operation a still of the capacity of 6,362
" quarts, and himself took from the condensers samples of the
" fat acids and glycerine, in strong solution and pure. At that
" time there were three apparatus of the same capacity in the
" factory.

" M. Wilson has succeeded in determining with such pre-
" cision the conditions under which glycerine volatilizes with-
" out alteration, that at this time, in the large factory we have
" mentioned, he is carrying on the rectification of this sub-

"stance so as to put it in the market in a chemically pure "state.

This successful result of Wilson's was subsequent to and suggested by seeing Tilghman's process in operation.

Wilson's Lecture delivered before Society of Arts *Record 87, p. 96.*

"I went with my chemist-assistant, Mr. Payne, to see Mr. "Tilghman's little apparatus *at work*, and in the course of "some experiments which it led us to try, or rather to try "over again, it struck me that steom passed into the fat at a "high temperature, should effect by a gentle process what Mr. "Tilghman aimed at affecting by a violent process, the resolving "of the neutral fat into glycerine and fat acids. In July, 1854 "we took out a patent for this process."

December 13, 1855, three months after M. Warren de la Rue had seen the three large stills working the steam distillation process, Wilson's Company obtained a license to work Tilghman's patent at £1,000 per annum. Record 87, pp. 75–6–7.

July 20, 1857, said licensees (Price's Patent Candle Co.) have a large apparatus in successful use on Tilghman's Patent. (Record 340, p. 406.) which, with one or more like it, remained in use when last heard from, July, 1865, (Record 340, p. 353.)

We maintain that the steam distillation of neutral fat so as to decompose them into fat acids and glycerine was never accomplished until Wilson did it after Tilghman's patent, and even then it was found so slow, expensive and imperfect that it has never been more than a *mere chemical curiosity* at the inventior's own factory; and was practically abandoned as a manufacturing process even there in favor of Tilghman's process as soon as they purchased the right to use it. Not a single factory in the world is asserted as working by this steam

process of Wilson, although the apparatus is in daily use in every distillation factory. Appellant's wituess, Smith, a fat acid manufacturer. Record 87, p. 223.

X Q. 68. Why have you not adopted this process of steam distillation *without the use of sulphuric acid* for obtaining fat acid and glycerine within the last five years?

A. Because we thought it would cost too much money.

X Q. 69. Was that the conclusion of the result of experiment?

A. No, sir.

X Q. 70. Why did you think it would cost too much money?

A. From the representations of other manufacturers.

X Q. 71. What manufacturers?

A. I am not bound to state, I believe; it was from a Boston gentleman.

X Q. 22. Was he a manufacturer, and what was his name and in what way did you deem it too expensive?

A. He was a manufacturer. His name was Hawes, I think. I deemed it too expensive because the apparatus cost too much.

JOHN H. SMITH.

PROOFS OF NOVELTY OF TILGHMAN'S PATENT.

Tilghman was the first to announce it, even as a scientific fact, that highly heated *water* under *pressure* would decompose neutral fats into fat acid and glycerine.

Admission by appellant's witnesses.

Appellant himself—Mitchell—Rec. 340, p. 375.

Q. 99. When did you first see neutral fats decomposed into fat acids and glycerine by the use of highly-heated water under pressure, knowing at the time that such a mode of decomposition could be used without the aid of chemicals?

A. I have known for more than forty years that fats were acidified by moisture. I never knew that the products mentioned, fat acids and glycerine, could be obtained from fats by heat, water and pressure, until I heard of it in connection with the patent of Wright & Fouché, about 1859. Several years prior to that date, the complainant patented an entirely impracticable and worthless process, which never has been used

because it cannot be, and the products obtained which he claims to produce, which I heard of previously to the date of the patent of Wright & Fouché,s process.

Q. 100. When did you first employ highly-heated water under pressure, at your factory, to decompose neutral fat into fat acids and glycerine without the aid of chemicals?

A. It was sometime in 1860, in December of that year.

Appellant's partner, F. Verdin, Def. Test. Rec. 87, p. 228.

XQ. When did you first see it stated in a book or document that highly-heated water under pressure would, without the aid of chemicals, decompose neutral fat into fat acid and a solution of glycerine?

A. I don't know when.

XQ. 23. Can yon swear you ever saw that statement prior to the date of Mr. Tilghman's patent, January, 1854?

A. I can not.

Same witness, Rec. 340, p. 399.

Q. 75. When did you first see neutral fat decomposed into fat acids and a solution of glycerine by the action of water at a high temperature and pressure, knowing at the time that such a decomposition had been effected?

A. I first saw it in 1859 or 1860, when Wright & Fouché sold their patent to R. G. Mitchell & Co.

Q. 76. Down to that time, what agency had you employed to effect this decomposition of neutral fats?

A. I had employed lime, from twelve to fourteen pounds to one hundred pounds of fat, and sulphuric acid in proportion.

Q. 77. Why did you not, during all the time of your manufacturing prior to 1859, dispense with the use of lime and sulphuric acid, and substitute the use of highly-heated water under pressure?

A. Because I could not find a process better than the lime process, until Wright & Fouché introduced their process by the circulation of the water.

J. T. Verdin, Foreman of Appellant's factory, Record 87, page 212.

X. 53. Who was the first person who stated that there would be an advantage in decomposing fats into fat acids and glycer-

ine by the use of highly heated water retained in the liquid state by pressure and in the absence of lime?

A. I don't know of any one who said there would be an advantage in that.

X. 14. Who was the first person who stated that it was advisable to decompose fats in that way?

A. I think Mr. Tilghman was the first person to mention that fats would be decomposed by water at or about the melting point of lead; many before him have stated that water or its elements, without specifying any particular temperature, would do the same thing.

X. 55. Which of them, before Mr. Tilghman, stated that highly heated *water under pressure*, in absence of lime, would decompose fat into *fat acid* and *glycerine*, and quote the statement, and give the name of the person who made such statement?

A. I don't know of any one having stated it in that form.

Appellant's Experts. Pro. Vander Weyde, Record 87, p. 171.

X. 141. Please state who was the first person, within your knowledge, who made the explicit statement that fat acids and solution of glycerine could be obtained for manufacturing purposes by the action of liquid water on neutral fatty bodies, at temperatures above three hundred and fifty degrees Fahrenheit; and state when and where such statement was made. [Answer objected to as irrelevant to the question.]

X. 142. Question repeated and read over to the witness.

A. I have already in my answer stated that Mr. Tilghman, in his patent of 1854, made this statement; it reads thus: "I subject these fatty or oily bodies to the action of water, at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine."

Appellant's scientific witnesses, Prof. Smith and Wayne, though very astute in suggesting (from their present knowledge) what *might have been* the unknown and unrecorded results of ancient experiments, and what chemists of those days *ought to have discovered* therefrom, are yet unable to point out any prior announcement of the chemical fat which forms the basis

of complainant's patent—a fact so important so easily and clearly defined, as to be impossible to be mistaken or overlooked.

Dr. Smith, Record 340, p. 445.

Q. 107. Can you testify that you have ever seen any publication, of date earlier than January 9, 1854, in which it is explicitly mentioned that fats can be decomposed into free fat acids and glycerine by the action of liquid water at at a high temperature and pressure.

A. I can not testify that I have seen any publication earlier than January 9, 1854, in which it is explicitly mentioned that *fat acids and glycerine* can be produced in the manner referred to.

Prof. Wayne, Record 340, p. 478.

Q. 135. Can you swear that you have ever seen any publication of date earlier than January 9, 1854, in which it is explicitly mentioned that fats can be decomposed into free fat acids and glycerine, by the action of water at a high temperature and pressure? Please answer directly, yes, or no.

A. I have not seen such publication.

Appellant's witness Grant, a manufacturer of fat acids, Record 340, p. 538.

Q. 35. When did you first learn that fats could be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

A. Shortly after Mr. Richard A. Tilghman took out his patent—I can't fix the date—and from that patent.

Q. 36. Can you name any book, published prior to 1854, in which it is distinctly stated that fats can be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

A. No, I cannot.

APPELLEE'S WITNESSES.

Prof. Booth, Record No. 349, p. 223.

Q. 135. Does any one of defendants' exhibits, Nos. 1 to 19, contain a description of a process substantially resembling

complainant's process in principle and operation? Does any of said exhibits contain the announcement of the chemical fact upon which complainant's process is based?

A. Not one of the defendant's exhibits, from 1 to 19, describes a process substantially resembling the plaintiff's in principle or operation. Not one of said exhibits announces the cardinal fact of plaintiff's process, that fats are decomposed into fat acids and glycerine by the action of water at a high temperature and pressure.

Same witness, Record No. 340, p. 201-2.

Q. 33. From your knowledge of chemistry, who would you say was the discoverer of the chemical power of water in a liquid state, at a high temperature and pressure on fats, to produce fat acids and glycerine?

(Objected to as calling for incompetent testimony.)

A. Mr. Richard A. Tilghman.

Q. 34. Do you know of any other person who has claimed the merit of this discovery?

(Objected to as calling for incompetent testimony.)

A. I know of no other.

Q. 35. Is this discovery regarded as a new and important fact in chemistry?

(Objected to as being leading and incompetent.)

A. It is so regarded.

Prof. Rogers, Record No. 340, p. 296.

Q. 65. Do any of the defendant's exhibits, Nos. 1 to 21, contain a description of a process substantially resembling the process patented to complainant in principle and operation, or an announcement of the fundamental chemical fact upon which complainant's process is based, to wit: the decomposition of fat into fat acids and glycerine by the action of water at a high temperature and pressure?

A. I have studied very carefully and critically, with reference to the meaning of the language employed, the documents and treatises containing the matter brought forward in said exhibits, and I have been unable to recognize in any one of the descriptions a process substantially resembling the process patented to complainant; nor can I see in them any announcement of the fundamental chemical fact upon which the complainant's process is based—the decomposition of fats into fat acids and glycerine by the action of water at a high temperature and pressure.

Prof. F. A. Genth, Record 87. p. 70.

Q. 4. Have you read, and do you understand the defendant's Exhibits, from 1 to 15, and from 18 to 20 inclusive? and if so, state whether or not you find described in any of them the process set forth and claimed in the plaintiff's patent? (Same objection.)

A. I have read and do understand the defendant's Exhibits referred to, and find that in neither one of them any mention is made of a process to decompose neutra fatty substances by highly heated water under pressure, but that they speak of various matters not in the least connected with this question.

Prof. Robert Bridges, Record 87, p. 56.

Q. 4. Have you read, and do you understand the defendant's Exhibits, numbered from 1 to 15 inclusive, and from 18 to 20 inclusive? And if so, state whether or not you find described in them or any of them the process set forth and claimed in plaintiff's patent? (Objected to by defendant. Same objection as heretofore.)

A. I have read the above-mentioned Exhibits, and do not find in them or any of them, any account of a process of decomposing fats by means of water at a high temperature and under high pressure, and do not find therein given the process of complaint as exhibited in his Letters Patent.

Prof. Wolcott Gibbs, goes over appellant's Exhibits one by one and thus concludes. Record No. 87, p. 15.

Q. 50. State when and by whom your attention was first called to the question of the *novelty* of the plaintiff's patented invention, *as affected by defendant's exhibits?* State whether you then made a full investigation of the subject, and report and state the substance of any such report.

A. (Objected to.) My attention thereto was first called by Mr. Mitchell, the defendant, in the early part of the year 1863. I then made a full investigation of the subject at his request, and gave him a written opinion, the substance of which was ***that the plaintiff's invention was new.***

The entire novelty of the plaintiff's discovery, that water at high temperature and pressure would alone decompose fats, is strikingly shown by the fact that Prof. J. C. Booth, when informed by the plaintiff in 1853 of the ***results*** only of his pro-

cess, was unable to suggest the means by which they could be obtained. When it is remembered that Prof. Booth had regularly lectured on this manufacture during ten years in which he was Professor of Chemistry applied to the arts, at the Franklin Institute, Philadelphia, and had in 1852 made a full "Report on the Progress of Chemical Manufactures," at the request of the Smithsonian Institute of Washington (Record 87, p. 26), it will be admitted that no one would be more likely to be fully informed of all that was really known on the subject to chemists at that time.

J. C. Booth, Record 87, p. 40.

Q. 48. Did Mr. Tilghman, complainant, mention to you the results obtained by him in decomposing sat, and if so, when first, and state whether or not you were able with your knowledge then, to state how the thing was accomplished? (Declaration of complainant objected to by defendant's counsel.)

A. Mr. Tilghman mentioned to me some time in the fall of 1853, that he could decompose fats so as to get their products without the use of chemicals, and that he was just on the point of leaving for Europe to take out a patent for the process. I told him in reply that I could not conceive how the decomposition could be performed unless by electricity.

It is proved by appellant's Exhibit 19, that although it had long been well known that the elements of water are always *taken up* or *absorbed* when fat is decomposed by the powerful alkalies or acids, yet, that it was entirely unknown to chemists in 1850, that *water* alone could decompose neutral fat into fat acid and glycerine.

Appellant's Exhibit 19, Record 87, p. 132, Q. 191.

In conclusion the saponification* of stearine on the supposition that it *could* be effected (*en supposant qu'elle put s' effectuer*) by the simple action of water *should* be expressed by the following equation.

Prof. Gibbs, Record 87, p. 14.

Q. 44. (Objected to.) State whether the passage in this exhibit commencing: "In conclusion, the saponification," &c., is or is not in effect a positive acknowledgment, that the decomposition of stearine into stearic acid and glycerine by the simple action of water, was not known to be practicable?

A. I think it is.

Prof. J. C. Booth, Record 87, p. 36.

In "Exhibit 19," from the Chemistry of Pelouze and Fremy, 1850, vol. 3, pages 570, and 571, there is a theory of the manner in which we should view the compounds of stearic acid, and in order to simplify the formula presented, the authors state that the saponification of stearic acid, on the supposition that it could be effected with the simple action of water, should be expressed by an equation in which stearine, supposed to consist of a hypothetical dry stearic acid and a hypothetical dry glycerine, would take up respectively 2 atoms and 1 atom of water to form hydrated stearic acid and glycerine. By their making the supposition "*if* the saponification *could* be effected by the simple action of water, "***it is evident they did not know that such an operation could be performed.***

Q. 4. Prof. F. A. Genth, Record 87, p. 70

* * * And, in fact, Exhibit 19 distinctly states, that there had not existed at that time any knowledge of the decomposition of neutral fatty substances by water.

Acknowledgement of Tilghman as discoverer of water process made prior to or outside of all litigation.

1856.—Lecture of G. F. Wilson before the Society of Arts, London. In full Record 87, p. 90, 96.

"In January, 1854, Mr. Tilghman, an American chemist, "who has studied all that has been published here and in "France, on the subject of acidification and distillation of fatty "bodies, obtained a patent for exposing fats and oils to the "action of water at a high temperature, and under great pres- "sure, in order to cause the combination of the water with the "elements of the neutral fats; so as to produce at the same "time free fat acids and solution of glycerine. He proposed "to effect this by pumping a mixture of fat and water, by

"means of a force pump, through a coil of pipe heated to about "612 Fahrenheit, kept under a pressure of about 2,000 lbs. to "the square inch; and he states that the vessel must be closed, "so that the requisite amount of pressure may be applied to "prevent the conversion of water into steam. This is, all "must admit, *a beautiful, original,* chemical idea, *well carried* "*out;* it has yet to be proved how far it can compete success- "fully with distillation. We have made an arrangement with "Mr. Tilghman which will give us the means of testing its "commercial merits."

1858. Plaintiff's Testimony, Tilghman *vs.* Werk. Record 340, p. 50.

U. S. PATENT OFFICE,

June 26, 1858.

SIR:—Your application for a patent for an improved treatment of fatty acids has been examined. You are referred to Reginault's Chemistry, vol. 2, p. 1594, to Payen's Chemie Industrielle, p. 771, and to the patents of R. A. Tilghman, January, 1855, and October, 1854.

MR. T. IS THE ACKNOWLEDGED DISCOVERER OF THIS PROCESS. The application is refused for want of novelty.

Respectfully, yours, &c.,

J. HOLT, *Commissioner.*

M. WERK, ESQ.,

(Care of Munn & Co.,)

New York.

The official reports of the juries of the International Exhibitions held in London in 1851 and 1862, and in Paris in 1855, give additional light upon the question of novelty of Tilghman's process.

These juries are known to be composed of the most eminent scientific and practical men in their respective branches to be found in Europe.

The report of the London Exhibition of 1851 contains a de-

tailed history of the rise and progress of this manufacture, from its origin by Chevreul down to 1851, including all the distillation and other processes referred to in defendant's exhibits.

Not one word can be found in that report alluding in any way to the process of decomposing fats by the action of water heated under pressure.

This was less than three years before Tilghman's patent.

The report of the Paris Exhibition of 1855 also gives the history of the various improvements in this manufacture, and states that Chevreul had discovered and announced all the chemical facts upon which they were based, "*with the exception of the "decomposition of the fats by water, which remained unknown "to him,*" and that Tilghman was the first to discover and propose this process.

The report of the London Exhibition of 1862 recognizes Tilghman as the inventor of the water process, awards him a medal therefor, and states that De Milly's process, with two and a half per cent. of lime, "*is, in fact, but a combination of "Tilghman's mode of saponification by water at a high temper-"ature, combined with the lime process.*"

These independent, unsought, and, as it were, accidental expressions of opinion, coming from such varied and competent authorities, cannot fail to have due weight with the Court.

EXPOSITION UNIVERSELLE DE 1855.

(Held at Paris.)

JURY REPORT.

Page 486. "STEARIC CANDLES."

Record No. 340, p. 356.

"* * The steric manufacture was originated in France. "It is founded upon the investigations of M. Chevreul as to the

"constitution of the fatty bodies. In a series of eight memories, "which will remain an imperishable monument of his sagacity, "this illustrious chemist has made known the true nature of the "neutral fatty bodies, the properties of the acids which we can "derive from them, and the conditions under which these acids "are formed. All the chemical investigations undertaken since "have only served to confirm the scrupulous accuracy of all "these observations. *We can affirm, without fear of contra-* "*diction,* THAT WITH THE EXCEPTION OF THE UN- "DERTAKING OF THE SAPONIFICATION OF THE "FATTY BODIES BY WATER, WHICH REMAINED "UNKNOWN TO HIM, *he has indicated in a clear and pre-* "*cise manner all the scientific bases upon which depend the dif-* "*ferent methods of practical manufacture of the fat acids em-* "*ployed for making candles.*"

Page 496. Aqueous saponification in a close vessel. Same report. Record No. 340, p. 523.

"Chemists liken neutral fatty matters to the compound ethers. "This hypothesis was put forth for the first time by M. Chev- "reul, in his "Researches on Fatty Bodies."

"As the "ethers" undouble when they are heated to a high "temperature in close vessels with water, one was led quite "naturally to attempt to effect this undoubling with the neutral "fatty bodies. Experience has confirmed this prevision. This "is the origin of the *new processes* of saponification which we "are about to set forth in a few words. *It was Mr. Richard* "*Albert Tilghman, chemist, of Philadelphia, who was the first* "*who had the idea of applying this reaction on a large scale.* "In his patent taken in London, the 25th of March, 1854, he "thus sets forth *his discovery,* and his manner of operating.

"My invention consists in a new method of obtaining free fat "acids and solution of glycerine from animal and vegetable fatty "and oily bodies which have glycerine as their base. * *

"My invention consists in exposing the aforesaid fats and oils "to the action of water at a high temperature and pressure, "the effect of which is to cause the combination of the water "with the elements of the neutral fats, so as to produce at the "same time free fat acids and solution of glycerine."

REPORTS OF JURIES. RECORD 340, P. 356.

INTERNATIONAL EXHIBITION, 1862. LONDON, 1863. CLASS IV.

Sect. A.—Oils, Fats, Wax, and their Products.

Jury.

"P. J. Van Kerchoff, Ph. D., Netherlands, Professor of "Chemistry in the University of Groningen. W. A. Miller, F. "R. S., President of Section, London, Professor of Chemistry, "King's College, London. Anseloma Paeyn, Deputy Chairman, "France, Member of the Institute, Prof. of the Conservatory of "Arts and Manufactures, and Professor to the Central School "of Arts and Manufactures. J. S. Stas, Belgium, Professor of "Chemistry at the Military School of Brussels, Member of the "Department of Science of the Royal Academy of Belgium. "Dr. Stein, Professor Dresden. George Wilson, F. R. S., "Joint Secretary, London, Manager of Price's Patent Candle "Works."

Associate.

"L. A. de Milly, France, Chemical manufacturer.

"Page 3. Considerations of this nature led M. de Milly, as "early as 1855, to endeavor to modify the process of saponifi- "cation by means of lime; instead of effecting this decomposi- "tion at a temperature of 212°, and employing 14 per cent. of "lime, he raised the temperature by working under pressure, "and employing only 4 per cent. of lime.

"At the present time M. de Milly has indeed reduced the "proportion of lime to 2½ per cent. This process has been "imitated in Austria. Undoubtedly it constitutes a real im- "provement upon the ordinary method of saponification by "lime; *but in spite of this considerable improvement,* WHICH "IS IN FACT BUT A COMBINATION OF MR. TILGHMAN'S MODE "OF SAPONIFICATION BY WATER AT A HIGH TEMPERATURE "COMBINED WITH THE LIMB PROCESS, we cannot believe that "these two methods of saponification, under any modification "at present attempted, can, in an economical point of view, "successfully compete with the sulphuric saponification.

Record 1, p. 81.—MEDALS, *United States.*—Page 7. TILGHMAN for fatty acids obtained by aqueous saponification.

Record 87, p. 270.—EXHIBIT P.

Muspratt's Chemistry, London, Vol. II, page 252, Article, Glycerine.

"A much more economical method is that introduced by "Tilghman, in 1854. By this process the fatty bodies are "broken up into acid and basic substances through the agency "of heat, pressure and steam, as described at p. 433, vol. I, "and form separate layers in the recipient into which the pro- "ducts flow from the condenser. The glycerine, which is the "heavier of the two, forms the lower stratum, and the fatty "acids of the upper; the latter can readily be separated me- "chanically, and the former left devoid of any impurity ex- "cepting water. By careful concentration the aqueous matter "can be expelled, and the product obtained of a specific gravity "of 1.24, and containing only four per cent. of moisture; but "by prolonging the operation, two per cent. more of water may "be removed, and the pure glycerine is left of a density 1.260.

Record 87, p. 270.—EXHIBIT Q.

Watts' Dictionary of Chemistry, London, 1864, Vol. II, p. 886, Article, Glycerine.

"3. By heating neutral fats with water or with steam. This "is the only unobjectionable method of obtaining glycerine, "inasmuch as it alone insures the entire absence of mineral "impurities. It was first carried out by Mr. Tilghman in the "following manner: the fat or oil having been thoroughly "mixed to an emulsion with about half its bulk of warm water, "isforced by a pump through a long coil of strong iron tubing "heated to about the temperature of melted lead, the pump "being worked at such a rate that the liquid may occupy about "ten minutes in traveling through the coil. On issuing from "the coil the liquid separates into two layers, the upper of "which consists of the fatty acids, and the lower of an aqueous "solution of glycerine, which requires only to be concentrated by "evaporation. This process is very simple, and is capable of "yielding very pure products.

Practical Character of Tilghman's Process in both forms of apparatus.

Tilghman did practically apply this discovery, and he was the *first* practically to apply it in the arts.

He described in his patent two modes of applying it; the first was an ordinary digester, such as was then well known.

Record 87, p. 4.

I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in *any convenient vessel* in which it can be heated to the melting point of lead, until the operation is complete. The vessel must be *closed* and of *great strength*, so that ths requisite amount of pressure may be applied to prevent the conversion of the water into steam.

This form of apparatus, the simple digester, was proved to work the plaintiff's process successfully at all temperatures, from lead melting heat, or 612°, down to 320° F.

Prof. Booth. Record 340, p. 202.

Q 36. Have you made any experiments on the action of water at high temperatures and pressures upon fats? If you state when and where, describe the experiments in detail, and describe the results produced. If you deposited samples of the products of those experiments with any person, state when and with whom.

A. I made two experiments on the action of heated water on fat, in my laboratory, in August, 1860. In the first experiment lard was heated with twice its weight of water to 320° Fah. during eleven hours. All the water was drawn off and a small amount of fatty matter. The water contained glycerine, a sample of which was produced on the 4th of September, 1860, in the case of Tilghman *vs.* Werk, was deposited with the Commissioner, and marked No. 1, A. (C. F. H.) The quantity of glycerine proved that more than four-fifths of the lard had been resolved into fat acid and glycerine; a sample of the fatty product thus obtained was produced and deposited like the above sample, marked No. 1 A. (C. F. H.) Its highly acid character was proved by its hardness, as compared with the lard, by its

crystalization, by its decomposing carbonated alkali with effervescence, by its great solubility in alcohol, and that this alcoholic solution reddened blue litmus. A sample of the lard used in this and the following described experiments was presented and deposited as above, and marked 1, C. (C. F. H.) The fatty product was again treated with twice its weight of fresh water, to 320° Fahr., for thirteen hours more, making twenty-four hours the whole time of its being heated to 320° Fahr. At the conclusion of this last time, the lard had been wholly resolved into fat acid and glycerine; the fat acid thus obtained was presented and deposited as above, marked 1, B. (C. F. H.) In the second experiment the lard was heated with twice its weight of water, but kept apart from each other, up to 612° Fahr, and when this temperature of 612° had been attained, they were mixed by agitation and kept heated at 612° during five minutes. The lard was wholly resolved into fat acid and glycerine, samples of which were produced and deposited as above, marked No. 3 fat acids, No. 3 glycerine, (C. F. H.)

Same witness, Rec. 340, p. 227.

Q. 149. Have you made any experiments to carry into literal execution the first described method mentioned in Tilghman's patent? If so, state the details when said experiments were made, and with whom you deposited samples of the product.

A. I made such an experiment on the 23d of March, 1864, in Philadelphia, by enclosing several ounces of pressed lard, with half as much water, in an iron tube lined with copper, tightly closing the same, and subjecting the mixture to the temperature of melting lead for forty minutes, without disturbing the vessel during that time, then cooling it rapidly with cold water, and pouring out the contents. I produced Exhibit R 1, as a sample of the glycerine water, as poured out from the tube and through filtering paper after *rendering* the mixed fat acids and glycerine water, and deposited it with the Commissioner in said suit against Mitchell. The glycerine water was subjected to no other process. I deposited Exhibit R 2, in the same suit, as a specimen of the fat acids rendered in this operation, and which had received no other treatment. I deposited in the same suit Exhibit R 3, as another portion of the rendered fat acid of this operation, settled, or clarified, by dilute sulphuric acid, and which has received no other treatment.

Tilghman's patent describes a special apparatus, which he

considers the best form for applying his process continuously, but expressly disclaims limiting himself to it.

Tilghman's Patent, Rec. 87, p. 5.

In the drawing hereunto annexed are shown figures of an paparatus for performing this process speedily and continuously, *but which apparatus I do not intend to claim as any part of my invention.*

This special apparatus is shown by the declaration of George F. Wilson to have been successfully worked by Tilghman before him in 1854.

Wilson's Lecture delivered before Society of Arts, Rec. 87, p. 96.

He proposed to effect this by pumping a mixture of fat and water, by means of a force pump, through a coil of pipe heated to about 612° Fahrenheit, kept under a pressure of about 2,000 pounds to the square inch; and he states that the vessel must be closed, so that the requisite amount of pressure may be applied to prevent the conversion of water into steam.

I went with my chemist assistant, Mr. Payne, to see Mr. Tilghman's little apparatus *at work*, and in the course of some experiments which *it* led us to try, or rather to try over again, it struck me that steam passed into the fat at a high temperature should effect by a gentle process what Mr. Tilghman aimed at effecting by a violent process—the resolving of the neutral fat into glycerine and fat acids. In July, 1854, we took out a patent for this process.

The testimony of Tilghman (Record 87, p. 75) shows that Price's Patent Candle Company, of which G. F. Wilson is Managing Director, took a license at £1,000 a year, and although they have the option of abrogating this license, they have not done so, but have continued to pay £1,000 a year for eight and a half years.

The following witnesses, who tried the coil apparatus of Tilghman, produced specimens in Court, and testified as to its practical character.

Professor J. C. Booth, the chemist of the United States Mint, and author of the Encyclopœdia of Chemistry, states:

Record 340, p. 224.

"I tried the second apparatus, indicated in the patent, with "an apparatus quite similar to to the drawing accompanying the "specification to Mr. Tilghman's patent, except that the coil "was circular, rising in a continuous spiral coil from below "upwards, so that the exit pipe came from the upper part in- "stead of the lower, as indicated in said drawing. There was "a force pump drawing an emulsion of melted fat and water "from a vessel in which it was heated and agitated, and forcing "it into the coiled tube, which was heated by a fire to about "the melting point of lead. The exit pipe outside the heating "apparatus formed another shorter coil, which was cooled by "water to below 212° Fahr.; and terminated in a final exit "pipe, which was controlled by a weighted valve. The pipe "of the whole coil had a full inch exterior, and a full half inch "interior, diameter. The temperature was determined by "three tubes closed at their lower ends, abutting against the "outside of the heated coil, and containing, respectively, bismuth, "lead, and saltpetre. The temperature was shown during the "working by the saltpetre being never melted, the bismuth "melted all the time, and the lead melted nearly the whole "time, except during a few minutes of solidification. The "weight on the exit valve was arranged to counter-balance the "pressure in the coil, so that material would only flow out "when the force pump was worked. We measured nearly two "gallons of pressed lard, and one gallon of water, which passed "through the apparatus in less than an hour. I produced a "specimen of the pressed lard used, deposited it with the Com- "missioner, as Exhibit V 1, in the suit of Richard A. Tilgh- "man *vs.* Roland G. Mitchell, in equity, in the Circuit Court "of the United States for the Southern District of New York. "I also produced a specimen of the product passed through the "apparatus, which I deposited with the Commissioner marked "V 2.

"The fatty product from the apparatus ran out of the con- "sistence of soft butter nearly the whole time. When it ran "thinner a sample was taken, produced, and deposited, as Ex- "hibit V 3, with same Commissioner, in same suit; it solidified "on cooling. The aqueous liquid which separated on *rendering*

"a basin full of the product, that is, by keeping it melted for a "short time, was evaporated and yielded glycerine, which was "deposited as Exhibit V 4 in same suit.

"The fatty matter which came through the apparatus was "tested by hot alcohol, and found to dissolve entirely, and on "cooling the solution very little unaltered fat separated from "it. I estimated not one per cent. The pressed lard tried in "the same way was almost wholly insoluble in alcohol. As "pressed lard was used, and the product consisted of glycerine "and crystalized fat acid, and matter from which mere traces "of unaltered fat were obtained, the decomposition was practi- "tically complete. I performed this experiment March 9, "1864."

Q. 140. From the character of the results which you obtained, what is your opinion as to the practical utility of the process of Mr. Tilghman?

A. As we obtained at the rate of four hundred to four hundred and fifty pounds in twenty-four hours, in so small an apparatus, and as the product consisted of fat acid and glycerine, I regard the process as a most perfect manufacturing process—that is, making fat acid and glycerine in an economical manner, and adapted to commercial uses.

Dr. Robert E. Rogers, Professor of Chemistry in the University of Pennsylvania, also testifies to the perfectly successful working of Tilghman's coil apparatus.

Record 340, page 286.

Q. 32. Were you present at any trial of the process of complainant in the coil apparatus described in his patent? If so, state who was present, and whether or not in your opinion said apparatus is a practical one for carrying on said process of complainant.

A. I was present at a trial of the process referred to in the question, in company with Professor James C. Booth, Dr. Robert Bridges, and Mr. R. A. Tilghman. It is my opinion, and not only my opinion, but my thorough conviction, that it is a process altogether adapted to carrying out the method of Mr. Tilghman.

Q. 33. Was the value of the fat acid and solution of glycerine produced thereby impaired by the presence of acroleine, and if so, to what an extent?

A. The odor of the products evinced nothing offensive which would indicate the presence of acroleine as a hurtful substance, the small amount of oxide of iron being an accidental, and not necessarily present substance, and was readily removable.

Professor Booth also proved the *quality* of the fat acid and glycerine produced by Tilghman's coil apparatus, by submitting them to the regular processes used in candle works.

Record 340, page 228.

Q. 152. Have you made any experiments on the practical mode of purifying and pressing the fat acids produced in your trial of Tilghman's coil apparatus? If so, describe such experiments, and state with whom you deposited samples of the products.

A. I rendered a quantity of the fat acids obtained by me with the coil apparatus, by boiling by means of steam with diluted sulphuric acid and allowing the fat acids floating on the aqueous liquid to cool to a solid mass. I deposited exhibit Q 1 as a sample of such cooled solid mass, in said Mitchell suit, with the Commissioner. A portion of the solid mass was subjected to cold pressure, and then to warm pressure, between copper plates, to remove the fluid fatty matters, and the remainder, consisting of solid fat acids, was cast into a glass tube and deposited with the commissioner in the same suit as Exhibit Q 2. Another portion of such solid fat acids was cast into a porcelain crucible and deposited with the Commissioner in said suit as exhibit Q 3.

Q. 153. Can you state of your own knowledge whether the working of Tilghman's coil apparatus produces fat acids fit for making candles, and glycerine fit to be sold as a commercial product, after purification by the ordinary methods?

A. By comparing the solid fat acids obtained by the coil apparatus, and subsequent clarification and pressure, with the solid fat acids obtained in Grant's candle factory, in Philadelphia, by the sulphuric saponification, I believe that the product of the coil apparatus is fit for making candles. By comparing the glycerine which I obtained by the coil apparatus with several kinds of glycerine of commerce, I believe that the coil apparatus will make a glycerine suitable for commercial purposes, equal to that produced by any other process, after resorting to the usual method of purification.

The appellant's witnesses cannot deny that with the coil

apparatus of Tilghman, even as tried by themselves, both fat acid and glycerine were always obtained; they are therefore limited to objecting to the bad *smell* of the products, a result due entirely to their own mismanagement of the process, and not produced as proved above, when the directions of the patent are complied with.

Appellant's partner, F. Verdin, Record 340, p. 389.

Q. 5. Have you made any experiments to ascertain whether he improvement described and claimed in said Letters Patent can be practically worked? If so, state fully what experiments you have made, when and where they were made, how they were made, and what was the result of the same.

A. I have tried—first, in a small vessel, six inches deep, half inch bore, with a valve at the end of it, kept down with a screw at the top, so that it would resist the pressure required. I filled the vessel one-third with water and two-thirds with fat, and immersed it in a potful of melted lead, and kept it immersed for ten minutes; afterwards I cooled it down rapidly, and by the opening I *found fatty acids* with *glycerine* and acroleine. I have made several more experiments in the same manner, and the results were the same. I made these experiments at R. G. Mitchell & Co's factory, about four years ago; I think in 1864.

This witness admits that these products had less color and smell than those of the sulphuric acidification process, and could be purified in the same well known way.

F. Verdin, Record 340, p. 398.

Q. 69. Was the fat acid produced in your experiments with the coil apparatus darker or lighter in color than fat acids acidified by sulphuric acid?

A. It was a great deal lighter.

Q. 70. In your opinion, could not the fat acids produced in your said experiments have been purified by distillation, in the same way as the darker fat acid acidified by sulphuric acid?

A. They could be purified by distillation, but it adds to the expense; for instead of one process you have two.

Q. 71. Would not distillation remove the smell as well as the color?

A. I do not think it would entirely, as there is always with

the distilled fatty acids a peculiar kind of smell, and that, I presume, results from the acroleine.

Q. 72. You mean that it would probably have the same smell as the distilled products of the sulphuric acid process, do you not?

A. The same as I smelled it in the Ohio candle works.

Q. 73. The distilled products in the sulphuric acid process are largely manufactured and sold in commerce, are they not?

A. They are.

This witness admits that in his trials of the coil apparatus, the directions of the patent that the tubes should be kept full of the mixture and free from steam, were not complied with.

Verdin, Record 340, p. 397.

Q. 55. In these explosions a large quantity of the mixture was thrown out at one time, was it not?

A. It was.

Q. 56. And the tubes were then partly empty of the mixture, and consequently so far filled with steam, were they not?

A. I suppose they were.

He also admits that he allowed only ten minutes for the mixture to go through the coil, whereas the patent directs that the mixture should be kept in the coil for ten minutes *after it had attained the temperature of melting lead.*

Record 340, p. 397.

Q. 61. In your experiments, the rate of working of the pump was the same at all the temperatures used, from melting tin to melting lead, was it?

A. It was always the same—so that it should take ten minutes to go through the coil. My aim was to complete the operation in ten minutes, as prescribed by the patent.

Appellant's French witness, Moinier, is the only one who testifies that the coil apparatus will not decompose fats into fat acids and glycerine.

Tilghman *vs.* Mitchell, Record 87, p. 294.

6th Int. * * The decomposition of the fatty matter was never complete, and never produced fat acid and glycerine. *

10th Int. * * The process never produced fat acids and glycerine.

14th Int. New experiments were made at La Villette, by Mr. Tilghman the younger, during the two or three months, and, like the first, produced neither fat acids nor glycerine.

16th Int. * * They produced neither fat acids nor glycerine.

14th X Int. * * First of all, it was necessary to obtain fat acids and glycerine, and we never obtained any.

Moinier is directly contradicted by appellant's witnesses, Mitchell and Verdin, who testify that they always obtained fat acids and glycerine, and some acroline, in the coil apparatus, and also by appellee's witnesses, Prof. Booth and Prof. Rogers, who obtained fat acids and glycerine with no appreciable acroleine.

Moinier further testifies that the supposed decomposition of fat by water at a high temperature and pressure *is an entire mistake*, and has no existence in fact.

Record 87, p. 298.

5th X Int. In my opinion, a mixture of fatty bodies and water, exposed in a closed vessel at a high temperature, and under a strong pressure, *cannot decompose* the fatty bodies to the point of producing fat acid and glycerine.

12th X Int. I have never thought, and I do not yet believe, that either Mr. Tilghman, the patentee, nor his brother, wished to deceive us; but I believe that they *were mistaken*, and that they are *still mistaken* about the fundamental question, namely, that a mixture of fatty matter and water is decomposed into fat acids and glycerine, when exposed to a high temperature and strong pressure in said tubular apparatus.

11th Int. I have also said, and I now affirm, that *it is impossible* to decompose fatty matter and obtain fat acids and glycerine by the method indicated in Mr. Tilghman's patent.

Moinier's own *actions* at the time of the experiments in 1856–7 are entirely irreconcileable with his account of the results of those experiments given ten years later, in his testimony of 1867.

If the experiments had "never produced fat acids and glycerine," it is plain he would not have persisted in repeating them for months together, at a large expense, and then, after a year's interval, again recommence them, paying the patentee each time for the privilege of doing so.

Mcinier's letter to appellee's agent, Fontaine Moreau, July 17, 1857, stating "that De Milly works by the Tilghman process," and urging complainant to sue De Milly for infringement, shows that at the date of the experiments Moinier regarded it as a real and efficient process.

Rec. 87, p. 272.

OFFICE FOR PATENTS OF INVENTION AND REGISTRATION OF DESIGNS,
39 RUE DE L'ECHIQUIER, PARIS—4 SOUTH STREET, FINSBURY,
LONDON, 18TH July, 1857.

R. A. TILGHMAN, Esq. :—

DEAR SIR: I cannot do better than to forward you the letter I have just received from M. Moinier, in answer to my queries relatively to the use M. de Milly was making of the patent infringing your process.

Yours, very truly,

[Signed] L. DE FONTAINE MOREAU.

Translation.

SOCIETE GENERALE DE STEARINERIE,
LA VILLETTE (NEAR PARIS), 17TH July, 1857.

MY DEAR FRIEND: I received your letter of yesterday, and I have to say that you have very well explained the position of De Milly, who cannot be prosecuted for infringement except by Mr. Tilghman, while, as you have well said, we are without qualification or right to do it.

Not only does De Milly work by the Tilghman process, but also he has sold to many candle manufacturers, amongst others to MM. Petit & Lemoult, the right to work his patent in France, in their factory at Grenelle.

Mr. de Milly has also sold in Belgium and in Austria, so that while the Messrs. Tilghman are in London and suspect

nothing, Mr. de Milly reaps a harvest in selling that which he has stolen from them.

What to say of all this so long as the Messrs. Tilghman are content to suffer themselves to be robbed?

You know De Milly; he does not lose his time; so he is more and more eager to offer his processes; he has offered them to us many times. If the Messrs. Tilghman wish to draw any profit from their patent, they ought to prosecute him for infringement as soon as possible.

Let them think of it seriously!

I am too much interested in the question to admit of my giving them advice which might perhaps be misinterpreted.

I must be content with wishing that Mr. Tilghman should have the courage to defend his intellectual property, that is to say, his honor.

I wrote to you yesterday, to beg you to execute a commission for my wife; but you will, of course, understand that you are only to attend to it if entirely convenient to you.

Your very devoted

(Signed,) MOINIER.

As Moinier's story carries its own refutation with it, it is here arranged in the order of date.

Moinier had seen at appellee's labratory, in London, the coil apparatus, and samples of fat acid and g[illegible]cine, said to be made with it. Before March 2 1855

Moinier, 6th cross-interrogatory and answer. Record No. 87, p. 298.

A preliminary agreement in writing was made between Tilghman and Moinier, providing that after experiments had been made "*to enable Moinier co judge of the efficacy and reality of the invention,*" a contract for the sale of the patent should be executed betore a notary. 1855 March 2

Moinier's letter. Record No. 87; p. 273.

The coil apparatus was brought to Paris, and worked at Moinier's factory. Many experiments were made with it. It was worked both by hand and by steam power. Between March 2 and July 24 1855

Moinier, 7, 8, and 9 cross-interrogatories and answers. Record No. 87, p. 295.

1855 July 24 — A formal contract of sale was made before a notary. 15,000 francs were paid to Tilghman.

Moinier, 10th cross-interrogatory and answer. Record 87, p. 299.

1856 Jan or Feb — After several attempts to get a large apparatus satisfactorily constructed in Paris, which occupied about six months after the date of the contract, it was annulled by consent of both parties.

Moinier, 9th int. and ans. Record No. 87, p. 295.

1857 July 17 — Moinier writes to appellee's agent, Fontainemoreau, advising Tilghman to sue De Milly, who is infringing his patent and robbing him.

Moinier's letter. Record No. 87, p. 271.

1858 Sept 13 — The patentee having returned to Philadelphia, a second written contract for sale of the patent was made between his agent Fontainemoreau and Moinier, Leroy & Durand. 12,000 or 15,000 francs were paid to Tilghman.

Moinier. 16th int. and ans. Record No. 87, p. p. 297.

1859 Nov 17 — Suit is brought by Moinier against Tilghman, absent in Philadelphia. He suppresses the fact that there was a *written agreement* which would have spoken for itself, and falsely asserts that the agreement of September 13, 1858, was *verbal*, and claims that it should be annulled, and 25,000 francs damages awarded. Record No. 87, p. 305.

1859 Dec 19 — Judgment by default for want of appearance, awarding 2,000 francs damages, to be collected by personal imprisonment. Record No. 87, p. 307.

1860 Feb 9 — Compromise between Tilghman's agent Fontainemoreau and

Moinier, by which the suit and judgment are vacated, the contract of September 13, 1858, annulled, and 1,000 francs paid by Moinier to Fontainemoreau, and the patent is reconveyed to Tilghman. Record No. 87, p. 315.

Moinier, examined on interrogatories by Mitchell, testifies that in none of the experiments made, eight to twelve years previously, was any fat acid or glycerine produced (10th, 14th, and 16th int.) That it is not true that water at a high temperature and pressure will decompose fats, and produce fat acids and glycerine (10thXint), and that Tilghman was mistaken in supposing so (12Xint).

1867
Aug 21

Moinier was then out of employment. His company, "General Company of Stearinery," was broken up, and another concern, Parisian Company of Stearinery was in possession of their factory, books and papers (1st and 2d int., Record 78, p. 293 and 294.

Now Moinier's story in 1867 as to the uniform failure to produce any fat acid and glycerine in 1855–8, is simply incredible in face of his own business acts, letters and payments of money at the time, all of which show a persistent belief in the "the reality and efficiency of the process."

The French jury of 1855, (Record 340, p. 523), who saw the coil apparatus in operation at Moinier's factory, say not a word as to its failure to produce fat acids and glycerine; they merely speak of the product as "not being deodorized," and having a "strong odor of acroline."

And we know from the experiments of appellant's witnesses, Mitchell and Verdin, that this smell is produced, *together with fat acid and glycerine*, whenever from accident or design the

tubes are permitted to become partly empty of the mixture, so that some of the water vaporizes and leaves the fat dry. And we know from Booth and Rogers, that this bad result does not occur when proper care is taken.

The failure of Tilghman at Paris, was merely a failure to sell his patent to Moinier on satisfactory terms, a failure consequent partly, upon the difficulty of getting a peculiar apparatus properly constructed and worked by foreign workmen, and in perhaps still greater degree, upon the peculiarities, mental and moral, of the party he had to deal with, and which appear in sufficient relief in Moinier's own testimony.

Appellee's witness, Joseph Nason, an engineer, who has used for many years tubes containing water at lead melting heat, proves that Tilghman's coil apparatus is entirely sufficient for the operation, and is a *safer* apparatus than the common form of boiler working at one hundred and eighty pounds pressure.

Record 87, p. 52.

Q. 5. Have you read, and do you understand, the descriptions and drawings of the coil apparatus in the patent of R. A. Tilghman, No. 11,766.

A. I have read the specifications and examined the drawing, and understand them.

Q. 6. Please state whether an apparatus constructed in accordance with said description, would or would not be a safe practical apparatus for heating the materials to a lead melting heat; and state what difficulty, if any, would be experienced in operating said apparatus at such temperature.

A. With ordinary care, I should consider it *perfectly safe.* I do not see that any practical difficulty would be incurred in its operation; so long as the temperature be limited to the melting point of lead, an apparatus as strongly constructed as those with which I have been familiar would be *almost absolutely secure against explosion.*

Q. 7. How would the safety of such an apparatus, used at lead melting heat, compare with that of an ordinary form of

steam boiler at a pressure, say of one hundred and eighty pounds, and what would be the relative effects in each case in case of explosion, if one should occur?

A. I should consider such an apparatus *much the safer of the two;* first, because its margin of strength beyond the strain to which it is subjected is many times greater; and second, because in the event of a rupture or explosion the consequences would be very much less serious in case of the tube than in the case of the boiler. When an explosion occurs in a tube of the small dimensions previously stated, it is scarcely ever attended with any more serious consequences than the temporary interruption of the work, and the expense of repairs. I will not undertake to state the consequences of the explosion of a steam boiler of any considerable dimensions, under the pressure of 180 pounds to the square inch. In regard to the effects of the explosion of such tubes when working at temperatures high enough to cause their rupture, I can speak from a good deal of experience. I have often seen ruptures from over-heating, and the result has usually been little more than a slight disturbance of the brick-work, or materials immediately contiguous.

Perkins' Scum, Defendants' Exhibits 1, 2, 3, and 19. Record 87, p. 388.

These exhibits do not pretend to describe any process for making fat acids or glycerine. They state that the fat used to grease a steam cylinder was found to be "changed" into a hard, waxy scum, which, when chemically examined, "resembled Chevreul's acids of fat" in two properties—solubility in alkalies, and solubility in alcohol; and also had other properties—not melting in boiling water, and insolubility in ether—which are admitted by defendants' witnesses to be entirely different and opposite to the properties of fat acids.

The exhibits do not assert the scum *to be fat acids,* but, on the contrary, afford positive chemical proof that it was *not fat acids.*

Glycerine is no where mentioned or alluded to. *The only*

mention of fat acids is in the following description of the properties of the changed fat:

Appellant's Exhibits Nos. 1 and 2. Record 87, p. 388.

"It does not melt in boiling water, but at a higher heat "melts, and ultimately burns like fat. It is rather lighter than "water; it dissolves readily in alkalies—more readily, I think, "than fat, *and in this respect resembles Chevreul's acids of fat,* "as well as in its solubility in alcohol; the alkaline solution is "turbid. It is not soluble in ether, or very slightly so; when "burnt, it leaves an ash consisting chiefly of carbonate of "lime."

Appellants' chemical experts admit that there is no fat acid known to chemists which possesses the two properties of the scum, viz.: not melting in boiling water, and insolubility in ether.

Appellant's expert, Dr. Smith. Record 340, p. 434.

Q 124. Did you ever see, hear of, or read of a free fat acid of oil or tallow which would not melt in boiling water, and was insoluble in ether, or nearly so?

A. I never did.

Q 124½. Can you, as a chemist, recognize a substance described as being insoluble in ether, or nearly so, to be free fat acid of oil or tallow?

A. So far as my memory serves me, I should say not.

Appellant's expert, E. S. Wayne. Record 340, p. 478.

Q 169. Is it anywhere stated in said exhibit that the "changed fat," or any product from it, "resembles Chevreul's acids of fat" in any other respect than "solubility in alcohol, and dissolving in alkalies more readily, I think, than fat?" If so, quote the words.

A. No, it is not.

Q 170. Are there not other properties of the "grayish substance" mentioned, viz.: "That it does not melt in boiling water, but at a higher heat melts, and ultimately burns like fat," and that "it is not soluble in ether, or very slightly so?"

A. Those properties of a grayish substance are mentioned.

Q. 171. Did you ever see, hear, or read of any acids of fat,

obtained from oil or tallow, which would not "melt in boiling water," and which was "not soluble in ether, or very slightly so?"

A. No.

Q. 172. Would chemists generally recognize as fat acids of oil and tallow (meaning thereby free fat acids) a substance which is described as being soluble in alcohol, and in alkalies, but not melting in boiling water, and insoluble in ether, or nearly so?

A. They would not.

Q. 173. Is it stated in said exhibit that any other portion of the "changed fat," besides the "grayish substance," resembles Chevreul's acids of fat? If so, quote the words.

A. It is not.

Appellant Mitchell, Rec. 340, p. 374.

Q. 83. Is fat acid soluble in ether?

A. I believe it is.

Q. 84. Did you ever see any fat acid, or know of the existence of any, which is not soluble in ether?

A. I cannot bring to my recollection any experiment to test the solubility of fat acids in ether, but I have no doubt I have made such, or seen them made, and therefore believe as before stated.

Q. 85. If all fat acids are soluble in ether, and if you found that a fatty substance was not soluble in ether, you would be satisfied that it was not a fat acid, would you not?

A. I should be satisfied it was not a free fat acid; but, as it is my opinion, based upon experiments with ether, which I have either made or seen made, I should also be satisfied that it was not a neutral fat, as that will be dissolved by ether.

Same witness, Rec. 340, p. 375.

Q. 97. In your experience as a manufacturer of fat acids, did you ever see fat acids that would not melt in boiling water?

A. Not unless they were in combination with some base.

Q. 98. Did you ever see a free fat acid that would not melt in boiling water?

A. Not to my knowledge.

Same witness, Rec. 340, p. 381.

I never saw any combination of fatty and other substances that did not melt in boiling water, but melted at a higher heat,

and ultimately burned like fat; consequently in this respect the properties in Exhibit No. 1 differ from any with which I am acquainted. Fatty acids, I believe, are soluble in ether, and so are neutral fats. If the product of Perkins' engine was not soluble in ether, it could not, in my opinion, be a neutral fat.

Q. 135. You say, "Fatty acids, I believe, are soluble in ether." "If the product of Perkins' engine was not soluble in ether," could it be a fatty acid?

A. It could not, in my opinion, be a pure fatty acid, and the product is not claimed to be such. It is stated "it is not soluble in ether, or very slightly so."

Appellee's partner, Verdin, Rec. 340, p. 402.

Q. 109. Did you ever see a free fat acid that would not melt in boiling water?

A. Not when it is entirely free.

Q. 110. Did you ever see a free fat acid that had been separated from impurities by being dissolved to a clear solution in hot alcohol, and afterwards precipitated from the alcohol by cooling, and melted, which would not melt in boiling water?

A. I have not.

Q. 111. Do you believe that any such fat acids exist?

A. Not if it is pure.

Q. 112. Did you ever see a free fat acid that was soluble in alcohol, and was insoluble in ether?

A. I have not.

Q. 113. Do you believe any such fat acids exist?

A. I do not.

Appellant's experts cannot testify positively, from the description in the exhibits, that there was any free fat acid in the scum; they merely *infer*, from their present knowledge of the decomposition of fat by water, (derived from appellee's patent,) that there *might* be some.

Appellant's witness, Dr. Smith, Record 340, p. 434.

Q. 123. Do you mean to say that your strongest reason for inferring that the product from Perkins' engine was free fat acid, is your present knowledge that fats will be decomposed into free fat acids and glycerine by the action of water at a high temperature and pressure?

A. The strongest inference is, as I stated above, that fat

can not be exposed to high heat, pressure, steam, with or without water, without undergoing decomposition.

Q. 134. Confining yourself strictly to the chemical properties of the "grayish substance," as they are described in exhibit 1, can you name any which would enable you to *testify positively* that said "grayish substance," contained any *free* fat acid whatever? If so, please state the properties.

A. None that would enable me to *testify positively* that such was the case, but some that *would lead me to infer* that such *might be the case.*

Q. 147. You have already stated that none of the chemical properties of the "grayish substance," as they are described in Exhibit 1, would enable you to *testify positively* that it contained any *free* fat acid whatever. I now ask you, which of the chemical properties of the "soft and even fluid substance," described (confining yourself strictly and accurately to the chemical properties described in the exhibit), would enable you to *testify positively* that said "soft and even fluid substance," contained any free fat acid whatever?

A. It must be understood that when I answered the cross-question 134, in regard to "testifying positively," I understand by testifying positively to mean, *to know to a certainty*, and with such an understanding I answered the first part of the cross-question 134, but adding in the same answer that there were some properties "that would lead me to *infer* that such *might be the case,*" viz., that there were free fat acids present; and for the same reason, while I cannot testify positively about the "soft and even fluid substance," on so short and imperfect a description as Exhibit No. 1, I am convinced that there are even stronger reasons *for supposing* that the soft and even fluid substance contained more or less free fat acid. For further elucidation of my opinion, see answer to cross-questions 125 and 138.

Appellant's witnesses, E. S. Wayne, Record 340, p. 477.

Q. 165. Please quote the words of said exhibit which announced the fact that fat can be decomposed into free fat acids and glycerine by water at a high temperature and pressure?

A. The exhibit does not say change of fat by Perkins' engine by the action of water, heat, and pressure, into fat acids and glycerine; it merely alludes to a change of fat. Upon the examination of the report, *and the knowledge I have of the decomposition of fats by heat and water, the only inference I can form,* is from the facts mentioned in the paper, that both fat acids

and glycerine were produced in the decomposition or change named.

Appellee's chemical experts testify positively that the chemical properties of the scum prove that it was not fat acid.

Professor J. C. Booth. Record 340, p. 207.

Q. 64. Explain in detail what fact is announced in Exhibit No. 1, entitled "change of fat in Perkins' engine by water, heat, and pressure."

A. That paper states that a mixture of olive oil and tallow was used to lubricate the piston of a steam engine, and was thus exposed to the action of steam at a high temperature and pressure, was carried on by the steam and produced in the condensed water a scum, differing in properties from the original fat. This scum was examined chemically, and its properties are described. The writer states that it dissolves readily in alkalies, "more readily, I think, than fats, and in this respect resembles Chevreul's acid of fat, as well as in its solubility in alcohol." It is also stated that the substance is not soluble in ether, or very slightly so, that it does not melt in boiling water, and that when burnt it leaves an ash consisting principally of carbonate of lime.

Each one of these last three named properties proves conclusively that the substance was not a fat acid of oil or tallow, for, on the contrary, a fat acid of oil and tallow is very soluble in ether, melts far below the heat of boiling water, and when burnt leaves no ash. The properties in which the scum is stated to have resembled Chevreul's acid of fat, namely, solubility in alkali, and solubility in hot alcohol, are *indecisive resemblances*, inasmuch as they belong also to neutral fats, and to soaps to a certain extent, the difference being one of degree only.

The properties described, which are distinct, positive, and decisive, and not mere resemblances, namely, insolubility in ether, melting point above 212° F., and leaving an ash of carbonate of lime, are *entirely different from the properties of fat acid.* This proves conclusively that *the scum was not fat acid.*

Q. 65. Have you examined the properties of the fat acids of a mixture of oil and tallow, and can you state from personal knowledge how they compare with those of the scum as described?

A. I prepared the fat acid of a mixture of equal parts of

olive oil and tallow, and treated it step by step in precisely the same manner as is described for the scum, namely, I dissolved it in hot alcohol, let it cool, and separated the precipitate which formed by cooling, and melted it.

I found its melting point to be 140° F., that it dissolved freely and perfectly in ether, and that when burnt it gave no ash. In all these properties it differed absolutely from the scum as described, which cannot consequently, have been the same substance. If the scum had been the fat acid of a mixture of oil and tallow, it would have melted far below 212° F.; it would have dissolved freely in ether, and when burnt would have left no ash. It is described as having *exactly the opposite properties, and cannot, therefore, have been the fat acids of a mixture of oil and tallow.*

Prof. R. E. Rogers, Record 340, p. 289.

Q. 40. Explain in detail wherein the process and results described in Exhibits 1, 2, 3, and 19, resemble, or differ, in principle and operation, from the process and results described in complainant's patent.

A. The important point of difference is that in these exhibits it is nowhere stated that any fat acid or glycerine was produced. It is, moreover, certain, from the chemical properties described that the *product* was not fat acids. Its resemblance to fat acids in two properties—solubility in alcohol, and in alkalies—is noticed by Faraday; but these properties are possessed by other fatty substances, such as neutral fats and soaps, and, therefore, are *resemblances*, and *only resemblances*, as the author calls them, and are not proofs of the identity with fat acids. The product differs from fat acids in three marked and distinctive characteristics, either one of which is sufficient to prove it to be a different chemical substance. Thus:

1st. The free fat acids are very soluble in ether. Faraday's product did not dissolve in ether, or very slightly. 2d. Fat acids melt at from 110° to 140°, according to whether they are pure stearic, or stearic acid mixed with oleic acid. Faraday's product would not melt in boiling water, 212° F. 3d. When burned, fat acids leave no ash, or the merest trace, if they have been prepared with lime. Faraday's product, when burned, left an ash chiefly of carbonate of lime. It is therefore inconsistent with chemical reasoning, it is absurd to infer that a substance having such unlike, even *opposite* properties, should be of the same chemical nature. With our present knowledge,

especially that derived from Tilghman's patent, we can see that if fat and water alone, without any other substance to combine with the fat acid, had been exposed to a heat and pressure in Perkins' generator, there would have been a formation of fat acid and glycerine. It is made certain by the statements of Faraday, that lime, in unknown quantity, was also present, and must have been brought in contact with the water and fat, and that it combined with the fat acid of the fat and formed a substance altogether different from a free *fat acid.* Had no lime been present, it is probable that the fat acid might have been recognized and announced as such, in which case Tilghman's discovery would have been anticipated by thirty years. As the facts exist, it is perfectly clear that neither Faraday nor any other chemist, from the year 1823 to 1854, regarded or announced the product described in the exhibits to be fat acids, and consequently the decomposition of fats into fat acids and glycerine by the action of water at a high temperature and pressure, remained unknown until Tilghman's patent.

Appellee's expert shows that the chemical properties of the changed fat as detailed in Exhibit 1 agree closely with those of neutral lime soap.

Professor Rogers testifies that he chemically examined a neutral lime soap made of a mixture of oil and tallow, in the precise way, step by step, as described by Faraday, and found its properties to agree entirely with those of Faraday's product.

Dr. R. E. Rogers, Record 340, p. 290.

Q. 43. Judging from all the properties of the substance as described in Exhibit 1, what do you infer it to have been?

A. I infer it to have been a neutral lime soap.

Q. 44. Have you made a chemical examination of the neutral lime soap, made from a mixture of equal parts of oil and tallow? If so, state how said lime soap was prepared, and what its properties are, as compared with those of the substance described in Exhibit 1.

A. I saw in Prof. Booth's laboratory a neutral lime soap, prepared by heating a mixture of equal parts of olive oil and tallow, with thirteen per cent. of lime and water, in a close copper vessel, at a temperature between the melting point of tin and

bismuth. It was a harsh and brittle substance, of a grayish color; it was dissolved by digesting in alcohol, and the clear solution, poured off while hot, on cooling deposited a white powder, which, when, collected and fused, formed a hard substance having a resemblance to wax, but more brittle and resinous; it was lighter than water; it did not dissolve in hot ether; it did not melt in boiling water at 212°, but at a higher temperature it melted and finally burned like fat, leaving a residue of carbonate of lime; on boiling with alkali it dissolved, giving a turbid solution; and on making a direct comparative trial it was found to dissolve in the alkaline solution more readily than neutral fat. The white powder which precipitated from the hot alcoholic solution by cooling was a stearate of lime, which is somewhat soluble in hot alcohol, but nearly insoluble in cold alcohol. The fluid substance obtained by evaporating the cold alcoholic solution was an oleate of lime, which is somewhat more soluble in cold alcohol. The neutral lime soap which I examined, therefore, agrees substantially with the substance whose properties are described by Faraday in Exhibit 1. As we know positively that the substance in Exhibit 1 contained lime as well as fat, and as its properties described agree so entirely with those of neutral lime soap, I infer that it was *neutral lime soap.*

Q. 45. Did you burn the fluid substance obtained by evaporating the cold alcoholic solution, (which you call oleate of lime,) and if so, did you obtain any ash, and of what nature?

A. I did burn a portion of that material, which left an ash, which ash was the carbonate of lime.

Appellant's expert, Dr. Smith, admits that he is ignorant as to whether the properties described by Faraday are those of a neutral lime soap or not.

Dr. Smith, Record 340, p. 435.

Q. 131. Will not a neutral lime soap, by digestion in hot alcohol, give a solution which, on cooling, will let fall a precipitate consisting of the larger portion of the neutral lime soap dissolved?

A. I have never tried this experiment, and cannot answer.

Q. 132. Can you testify positively to the contrary?

A. I cannot testify either one way or the other on a point in technical science that I have not experimented with, and about which I am told there is difference of opinions among those who

speak of the matter within their own authority, and that of others.

Q. 133. Will not a neutral lime soap dissolve in strong alkalies, making a turbid solution consisting of a solution of an akaline soap, holding in suspension free lime, which causes the turbidity?

A. That I cannot tell, but suppose it might; I cannot refer to any author who seems to have tried the experiment.

Appellant's witness admits that all the lime which existed naturally in the water used in Perkin's generator would combine with the fat and form lime soap, and that if this lime was equal to or in access of the chemical equivalent of the fat used, all this fat would be converted into lime soap, and there would not be any free fat acid produced.

Appellant Mitchell, Record 340, p. 362.

A. 17. Water is never found pure in nature. The most universal impurity being lime; fatty acids having a great affinity for lime, combine with any lime present in the water; and to free the fatty acid from this impurity, we treat it with a small quantity of sulphuric acid to purify it before making it into candles.

Same witness, Record 340, p 362.

A. 20. I have already stated that lime is almost universally found in water. The treatment of fat in the Perkins engine, by water, heat, and pressure, would necessarily acidify some portion of the fat, and that portion would combine with any lime found in the water.

Same Witness, Record 340, p. 379.

Q. 122. The whole of the lime existing in the water in the generator would combine with an equivalent quantity of the fat acid, and form lime soap, would it not?

A. That is my opinion.

Q. 123. If, then, a quantity of lime sufficient to combine with all the fat acid had existed in the water in the generator, the product would necessarily have been lime soap, without any mixture of free fat acid, would it not?

A. It certainly would; but Exhibit No. 1 shows, in my opinion, that the quantity of lime was not sufficient to combine with all the fat acid and form a lime soap.

Q. 126. And if the quantity of lime in the water had been largely in excess of the quantity equivalent to the fat acid, lime soap without any mixture of free fat acid, would have been produced, would it not?

A. If the quantity of lime in the water was more than sufficient to combine with the acidified fat, lime soap, without any mixture of free fat acids, would have been produced.

Dr. Smith, Record 340, p. 434.

Q. 128. Then the chemical combination known as "lime soap" must have been present in the "grayish substance" in quantity corresponding to the lime found in it, must it not?

A. I should say so.

Q. 129. And if the lime found in it was in quantity equivalent to the fat present, the "grayish substance" would have consisted entirely of neutral lime soap, would it not?

A. I should suppose so.

Q. 130. The question whether this grayish substance was a neutral lime soap or not would depend entirely upon an unknown fact, viz.: whether the unknown quantity of lime present in it was greater or less than the chemical equivalent of the unknown quantity of fat present in it. Is that so?

A. I should say it was.

Appellant's expert, Dr. Rand, testifies (Record 340, p. 519,) that ten pounds of Thames water contains lime enough to convert one hundred and eighty grains of fat into neutral lime soap.

It is agreed by counsel as a matter of general scientific information that a steam engine evaporates sixty-two pounds of water per hour for each horse power. It is proved by appellee's witness, Matthewson, a practical engineer (Record 340, p. 351,) and not contradicted by appellant, that a twenty-five horse power steam engine uses about three-quarters of a pound, or 5,250 grains of fat to grease the piston during ten hours,

or 525 grains of fat in one hour, in which time it would evaporate 62 × 25, or 1,550 pounds of water. This 1,550 pounds of Thames water would convert into neutral lime soap 155 × 180, or 27,900 grains of fat, which is fifty-three times the quantity used to grease the piston during the time of its evaporation.

It is true that in Perkins' engine the steam is described to be condensed, and this condensed water is pumped back into the generator; but it is expressly stated in the detailed description of the engine, in defendants' Exhibit 19, that *the cold water* used to condense the steam (and which thereby becomes heated) is ALSO PUMPED INTO THE GENERATOR.

Defendants' Exhibit No. 19, p. 26.

"The condensor *ll* is a tube of copper about four inches in diameter and twenty feet long, and is *supplied constantly with cold water* from the pump, through the pipe *n n*, which enters the condenser at the lower end, and is discharged at the upper end into the tube *r r*, which, proceeding to the lower part of the apparatus, ascends in a spiral winding of many coils round the bottom of the furnace up to valve *s*, which is also loaded by a variable weight *u*, equal to 700 lbs. upon the square inch, (or about 50 atmospheres;) from the valve *s* the tube descends as at *v v v*, and proceeds to nearly the bottom of the generator, as shown by the dotted line."

It is evident, therefore, that a mixture of *fresh water* and condensed water was constantly being pumped into the generator. What proportion of each was used is not stated.

It is a well-known scientific fact that five pounds of cold water, at 60° Fahr., are absolutely required to condense steam enough to produce one pound of water, the whole six pounds being thereby brought to the temperature of 212° Fahr. But the preceding calculation shows that if the fresh water used amounted to only one-fifty-third as much as the condensed water, or one-two hundred and sixty-fifth part of what was

necessary for complete condensation, there would still have been enough lime present to convert *all* the fat used for greasing the piston into neutral lime soap, and to prevent any of it existing as free fat acids.

The best practical proof that the public did not become informed of the process for decomposing fats into fat acids and glycerine by the action of water at a high temperature and pressure, by the publication of these exhibits in 1823, is the fact that for thirty-one years after (up to 1854, date of complainant's patent) no mention of such process is to be found in any chemical or technical work on the subject, and that manufacturers continued, year after year, to consume uselessly millions of pounds of lime and sulphuric acid to produce this decomposition, all of which they might have saved had they possessed the information alleged by appellant to be imparted by these exhibits.

Prof. Booth gives a list of ten chemical and twelve technical treatises of dates between 1823 and 1854, which refer to the subject, but do not mention the water decomposition. He gives another list of seven chemical and eight technical works, of dates later than 1854, all of which mention the water decomposition.

Booth, Record 340, page 208.

Q. 68. As a matter of chemical history, did or did not chemists become acquainted with that chemical fact from the publication of those exhibits in 1823? and explain how you form your opinion. Give a list of the chemical treatises you have examined on the subject.

A. Chemists did not become acquainted with that fact from the publication of those exhibits in 1823. When new chemical facts or discoveries are published, they are collected and embodied in standard chemical treatises which represent the state of the science at the date of their publication. To ascertain

whether a particular chemical fact was or was not known at a given date, say 1854, I should examine a number of the most authoritative treatises publlshed at or before that date, and if none of these contained any mention of that fact when treating on the subject to which it related, I should then be compelled to conclude that the fact was not then generally or publicly known to chemists.

If on examining new editions or treatises of a later date I found that several of them did mention the fact in question, I should then conclude that it had been discovered and first made public in the interval between the dates of the respective treatises.

I annex a list of standard chemical treatises of the highest authority, of dates between 1823 and 1854, which I have examined. They all contain descriptions of the properties of fat and fat acids, and the known methods of producing fat acids and glycerine. None of them mention the fact that fat acids and glycerine can be produced by the action of water on the fats at a high temperature and pressure.

I annex another list of standard chemical treatises of dates subsequent to April 3, 1854, all of which contain mention of that fact.

I therefore infer and conclude that that fact was first made known subsequent to 1852, and prior to April 3, 1854.

Prof. Booth, Record 340, page 210.

Q. 71. Please state in general terms the result of your examination of the standard chemical and technical publications?

A. None of the technical treatises or chemical works published prior to 1854, contains any mention either of the chemical fact of the decomposition of fat by water at a high temperature and pressure, or of the manufacturing process founded upon it. After 1854, both the chemical fact, and the manufacturing process are mentioned in numerous technical publications.

Professor Rogers, Record 340, page 289.

Q. 41. Is the chemical fact which forms the basis of complainant's process as patented, an interesting and important one, and would its first publication be likely to attract attention, and to be copied into chemical treatises? State what publications you have examined on the subject, and with what result.

A. Such decomposition and conversion is undoubtedly a most interesting and important chemical fact, both scientifically

and in its practical application to an extensive and useful manufacture; and any clear and distinct announcement of it, especially from such authority as Faraday, could not have failed to attract attention, and to have been copied into the chemical and technical treatises of the period. I have examined the chemical and technical works mentioned by Professor Booth, in answer to questions 68, and 69, and 70, of his direct examination in this case, and find that in those of dates earlier than 1854, there is no mention of or reference to this fact, while all those of dates later than 1854 do mention or refer to it. All the treatises referred to by Professor Booth, are standard works of the highest authority in their respective lines.

Appellant's experts cannot testify that the public got this information from the exhibits.

Dr. Smith, Record No, 340, page .

XQ. 196. As a matter of chemical history and record, *did* chemists generally become informed from the publication of Faraday's paper (defendants' Exhibit 1) of the fact that fats could be decomposed into free fat acids, and solution of glycerine by the action of water at a high temperature and pressure?

A. So far as my information goes, chemists generally seem to have paid but little attention to Faraday's paper, and consequently could not have become acquainted with the fact referred to.

In 1865, Prof. Faraday published a book upon the "Chemical History of a Candle," in which he describes the method of manufacturing fat acids, but does not mention, or allude in any way, to the process by water at a high temperature and pressure, supposed to have been discovered and announced by himself, in 1823.

Appellant's witnesses produce the most conclusive proof that the information imparted to the public by these Perkins scum exhibits was merely vague suggestion, and nothing definite or practical.

It appears that the appellant, M. Werk, had a knowledge of them about 1843, and then told the witness Verdin, that he had

learned that water "would do wonders" in the treatment of fats. They had an apparatus made, tried the experiment, and *utterly failed to decompose fats*, or to produce, as far as they knew, any fat acid or glycerine.

MANICLER'S PROCESS DIFFERENT FROM TILGHMAN'S.

Record 87, p. 241.

Manicler's patent of 1826 (Appellant's Ex. 15), is cited by appellant, but he does not pretend that it describes Tilghman's process, or that it produces or pretends to produce his results. Manicler himself states *nine* times in this patent that he obtains not fat acid and glycerine, but "*tallow.*" His experts admit that Manicler *himself* did not even *know* such a result would be obtained.

Def. witness, Vander Weyde. Record 87, p. 166.

X 108. Did you or did you not obtain a solution of glycerine when following Manicler's prescription?

A. I don't know, *neither did Manicler know it himself.*

Prof. Wolcott Gibbs, Rec. No. 87, p. 13.

Q. 37. What is the condition of the fatty matter after undergoing the process described in this patent (Exhibit 15), is it in the state of a free fat acid, or is it still a neutral fat?

A. It is still a neutral fat.

Q. 38. State if there are any positive proofs of this fact contained in this patent itself, and if so, mention them all in detail.

A. I will read the statement of the patentee, viz.:—

"Instead of preparing fatty substance from tallow by digesting with it water as hereinbefore described, the *same results* may be obtained by *melting tallow* in an ordinary boiler, and *adding oil of turpentine thereto* in the proportion of one part by weight of oil of turpentine to about seven parts by weight of tallow, the subsequent treatment of the tallow after being so melted with the oil of turpntine, being the same as if it had been digested by water in the manner hereinbefore described."

I consider this as positive proof that saponification had nothing whatever to do with Manicler's process, but the whole

patent very clearly shows that saponification was not intended or even thought of.

Appellant's expert, Vander Weyde, Record No. 87, p. 170.

X134. Do you know whether Bracconnot mixed melted neutral fats with spirits of turpentine, and after cooling, submitted said mixture to cold pressing? If yea, what was the result of such an operation—was the fat decomposed thereby into fat acid and glycerine, or was it produced in the state of a hard neutral fat?

A. The mixture of fat with turpentine will of course *not decompose the fat*, turpentine being a neutral body. It acts only as a solvent for the more fluid oleine, and has the effect of causing the oleine to be more completely removed by pressure from the stearine and margarine. These last two substances were the result. They are hard neutral fats.

Prof. J. C. Booth. Record No. 87, p. 35.

In comparing "Exhibit 15" with plaintiff's process I examined Manicler's patent from the printed specifications issued by the English Government. "Exhibit 15" describes a process for rendering tallow or raw fat with water under a pressure not greater than one atmosphere. That the object and result of the operation described in said exhibit is only to *render* the fat and *not to decompose it*, are proved from the statements in the exhibit that the solid fat requires great care in pressing to obtain it; that the solid fat obtained is so brittle that candles cannot be made of it without the addition of wax or boiled linseed oil, and that the liquid fat pressed out from the solid might be used as a lubricator, and that the patentee claims throughout that the resultant solid fat was still fat or tallow, by mentioning it no less than nine times in the patent, and he further states that the *same* result as by his process may be obtained by adding to the crude tallow oil of turpentine, melting it and pressing it to separate the solid from the liquid fat. There is not the slightest allusion through the whole patent to a fat acid, or to glycerine, nor to the decomposition of the tallow or fat, but only to the separation of liquid from solid fat. If a decomposition of the fat took place, the liquid fatty matter pressed out *could not* be used to burn in lamps, nor for oiling machinery, for which purpose, the patentee states, his oily matter can be used. If the decomposition of the fat had taken place, the solid fat acid resulting from pressure could be used for making

candles without the addition of wax or linseed oil. Since the same result is obtained by melting the crude fat with turpentine in an ordinary boiler and pressing, as by melting the crude fat with water at a pressure of one atmosphere, and since the so melting with turpentine cannot decompose the fat, and since the resulting products are identical, therefore no decomposition of the fat could possibly have taken place.

Prof. F. A. Genth, Record 87, p. 73.

IV. MANICLER.

1. Presence of heated water under pressure *not at all necessary*, as the admixture of spirits of turpentine produces the same results.

2. Produces, and intended to produce purified *neutral* fats.

3. Produces hard neutral fat "too granular and friable in its texture to be fit for making candles" without admixture of wax or boiled linseed oil.

4. Produces liquid neutral fat, or oil "oleine" suitable for oiling machinery, or burning in lamps.

IV. TILGHMAN.

1. Presence of highly heated water under pressure, absolutely necessary.

2. Decomposes the neutral fats, and produces free fatty acids and glycerine.

3. Solid fatty acids produced not friable, or granular, and fit for making candles without admixture.

4. Liquid fatty acid "Oleic acid," unfit for burning in lamps, or oiling machinery.

Manicler's was a mere hot water "rendering process," to get the fat free of the cellular tissue by which it is surrounded in the animal; and such a mode of rendering was pursued by the

defendants themselves from 1844 down to the present time as a mere "rendering process."

Appellant's partner, F. Verdin, Record 87, p.

X. 19. How long have you used Wilson's tank for rendering fats or known of its use?

A. I believe I have used it from 1844, and have rendered all my tallow with it.

Record 87, p.

Q. 13. [Objected to by defendant's counsel.] State whether Wilson's process is or is not substantially the same as that described in the first part of Manicler's patent and state also if lard so treated by Wilson's process had been subsequently cold and hot pressed, whether the candles produced therefrom would not be such as contemplated by Manicler's patent, and also like those in Exhibit "M?"

A. It seems to me that Wilson's process is identical in principal with the process indicated in the first part of Manicler's patent, according to the copy of the patent marked "Defendant's Exhibit 15."

AS TO EXPERT'S CONSTRUCTION OF APPELLEES SPECIFICATION.

The appellant has called Mr. E. S. Renwick, as an expert, and he favors us with his legal opinion as to the proper construction and meaning of the specification, particularly in regard to the range of temperatures covered by the claim.

We do not think it necessary or proper to offer any arguments to fortify the opinion of Judge Nelson against his criticism.

There is one point, however, where some explanation of the state of the art may clear up a complication attempted to be made.

In his search for reasons to limit appellee's process to temperatures above 440° F, the witness travels out to the speci-

fication, and quotes from appellee's original application and his British patent. The passage referred to reads:

"The second part of my said invention consists of a mode of "treating a mixture of fatty matters (whether acid or neutral) "and a carbonated alkali, for the purpose of manufacturing "soap.

"For this purpose, I mix the fatty bodies, in a liquid state, "with the quantity of carbonated alkali in solution which may "be necessary to convert it into soap, and then subject the mix- "ture to a high temperature under pressure, *in like manner as "herein before described* in practising my mode of obtaining "fatty acids and glycerine and for this purpose, *the apparatus "herein before described* for producing the fatty acids and "glycerine by a continuous process, may be used for the pro- "duction of soap *in a similar manner*. The carbonated alkali "may be dissolved merely in the quantity of water which is "intended to remain in the soap produced. If resinous or other "matters are intended to be used in the manufacture of the soap, "they may be dissolved either in the alkaline solution or the "oil, or may be combined with the soap after it has left the "apparatus.

"The degree of heat required is less than that which is neces- "sary to produce free fat acids, and should generally be kept "between the melting points of tin and bismuth. At about "three hundred and fifty degrees of Fahrenheit the neutral "fats will form soaps, with the solution of alkaline carbonates, "but a higher temperature will produce the result more "quickly.

"The carbonic acid expelled from the alkali in this process, "when performed in the *apparatus above described*, escapes as "the soap issues from the exit valve; if but little water has "been used, and the quality of the soap is sufficiently good "without further purification, it can be put into frames to "harden at once, or it may be put into the coppers, boiled up, "and separated from the glycerine (when neutral fats have "been used), and finished in the usual manner."

The plain meaning of the passage referring to the degree of heat is, that when working the soap process in *the same way* as directed for the fat acid process, that is, in the *same form of apparatus*, and with the mixtures passing through it at the

same rate, and being exposed to the heat during the *same length of time*, the complete conversion of a mixture of fat and carbonated alkali into soap and glycerine will take place at a lower temperature than would be required to effect in the *same length of time* the complete conversion of a mixture of fat and water into fat acid and glycerine.

The affinity of the alkali for the fat, and its emulsionizing tendency, helps the decomposing action of the water, and causes it produce the decomposition, either at a lower temperature, if the same length of time is given, or in a shorter time, if the same temperature is employed, than in the case where water alone is used, and has to do all the work of decomposition, and to produce fat acid in a free state, with its acid affinities unsatisfied. That is, *using the same length of time in both cases*, water plus carbonated alkali, will decompose fat and form soap at a lower temperature than that at which water alone will decompose fat and form free fat acid.

The next sentence recommends the practical lower limit of temperature for working "the apparatus hereinbefore described," "in like manner as hereinbefore described," when "used for the production of soap in a similar manner," at about 350° Fahrenheit, and adds "but a higher temperature will produce the result more quickly." Mr. Renwick would have us believe that the patentee meant to assert that 350° Fahrenheit was the *lowest temperature* at which fat and carbonated alkali will form soap, *no matter how long a time is given*, and that as it is said, "that the heat required is less than that which is necessary to produce free fat acids," the patentee in effect declares that no fat acids will be produced except at temperatures above 350°, no matter how long a time is given.

Now, the prior state of the art and current knowledge of the subject matter is to be kept in view in construing the specification, and we learn from defendant's own experts, Smith and Wayne, that it has been notorious for 40 years, that at 212° Fahrenheit, and in open vessels, fat and carbonate alkali will form soap, only they require a long time to do it completely.

Prof. Smith, Record No. 340, p. 442.

X Q. 170. Has it been known to chemists since the time of Chevreul, that neutral fats will form soaps with alkaline carbonates (of potash and soda) by long boiling at 212° F.?

A. Chevreul, I believe to have been the first person to show that boiling fats and a solution of carbonate of potash would result, after a long continued action, in the formation of soap. and what is true of the carbonate of pot[illegible]s equally true of the carbonate of soda. The proportions of [illegible]ts and carbonate of potash employed by Chevreul were one part of fat and two of crystalized carbonate of potash.

Prof. Wayne, Record 340, p. 432.

X Q. 206. Has it been generally known to chemists, and published in standard chemical treatises, prior to 1854, that solutions of alkaline carbonates would form soaps with neutral fats, by long boiling therewith at 212° F.; if so, please describe the successive stages of the operation.

Renwick's Interpretation of Claim.

Edward S. Renwick, appellant's expert, fixes the minimum of Tilghman's process at 440°, and not 510°, as appellant's brief does. (E. S. Renwick, Rec. 340, p. 562.)

"Q. 2. Are you acquainted with Letters Patent No. 11,766, granted to complainant, dated the 3d of October, 1854, for improvement in process for purifying fatty bodies; and, if yea, state fully the kind of apparatus in which the process is described to be carried on, and at what temperatures the fatty bodies are to be decomposed?

"A. I am acquainted with the contents of Letters Patent No. 11,766, referred to in the question, by having carefully examined a printed copy thereof." * * * * "The temperature at which the fatty bodies are to be decomposed is one at or about the melting point of lead, which is above the temperature at which fats begin to decompese by heat alone, even in open vessels. The patentee in one place states that the change or decomposition takes place with some materials, such as palm-oil, at or below the melting point of bismuth, (510° F.) It also gives the test of melting tin (440° F.) as the lowest temperature which the operator need take any note of, and the test of melted nitrate of potash (660° F.) as the highest temperature which the operator need take any note of. These tests, coupled with the absence of any statement that the process can be operated at a temperature as low as the melting point of tin, with any fat matter, show *that the temperature relied upon is one exceeding the melting point of tin*, (440° *F.*,) and not exceeding the melting point of nitrate of potash, (660° F.,) the temperature of the melting point of lead (612° F.) being the temperature for general practice."

DANIELL'S BAROMETER.

Appellee's counsel should, perhaps, apologize to the eminent counsel for the appellant's for venturing to suppose that they will seriously urge the Daniell's Barometer Exhibit upon the attention of this court.

In the transactions of the Royal Society (London) for 1832,

Prof. Daniell gives an account of some experiments made by him with a water barometer, composed of a glass tube over forty feet long by one inch bore, placed vertically; the lower end of the tube went into the water of a little boiler, so that, by raising steam on the boiler, the pressure forced the water to rise in the long glass tube to its top, which was then sealed up, and the steam allowed to subside, and the water fell to the barometric height. As the water in the boiler had been carefully freed from air by long boiling, it was desired to prevent it from reabsorbing any when cold. (Record 87, p. 389.)

The appearance of some drops of an aqueous fluid, of a sweet taste, resembling glycerine, along with carbonaceous matter, *on the top* of this castor oil, after it had been exposed to the air *during two years*, in the cistern of this water barometer, does not present at first sight, to the ordinary mind, any great resemblance to a process for manufacturing fat acids and glycerine, by mixing fat and water, in a close vessel, at a high temperature and pressure, during six or eight hours.

Dr. Vanderwyde, that learned chemical expert of appellant, however, (Record 87, p. 402,) considers Daniell to have here announced to the world, in 1832, the chemical fact, that water at the ordinary temperature of the air would decompose fat into fat acid and glycerine. Daniell himself published a chemistry, in 1843, in which he describes the common processes for decomposing fats and making fat acids and glycerine, but says not a word of this remarkable discovery which Dr. Vanderwyde discovers him to have made eleven years before. Prof. Booth was examined as to this barometer, and explains it fully. (Record, pp. 216, 298–104, 340.)

"Q. 98. Have you read, and do you understand, defend-

ant's Exhibit 9, and have you examined the original publication in the Philosophical Transactions?

"A. I have read, and I understand it; and I examined the original paper in the Philosophical Transaction.

"Q. 99. Does Exhibit 9 contain any evidence of a prior knowledge or use of complainant's process?

"A. It does not.

"Q. 100. Does it contain any announcement of the chemical fact that fat can be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

"A. It does not.

"Q. 101. Explain what fact is announced in that paper?

"A. It is stated that a stratum of castor oil was placed on the surface of the water, in the cistern of a water barometer, and that after the lapse of nearly two years some drops of a liquid resembling glycerine were formed on the surface, of a mucilaginous substance, which had formed on the top of the oil.

"Q. 102. Is it anywhere stated in that paper that the oil was ever exposed, in contact with the water, to a high temperature and pressure?

"A. It is not.

"Q. 103. Has that paper any real connection with, or relation to, the process claimed in Tilghman's patent, or the chemical fact on which it is based?

"A. It has not the slightest.

"Q. 104. State whether you have examined Daniell's Introduction to Chemical Philosophy, London, 1843, pages 616, 617; whether it is by the same author as Exhibit 9; whether it contains descriptions of the known methods of decomposing fat acids, making fat acids, and whether it contains any mention of the process of decomposing fats into fat acids and glycerine by the action of water, either at common temperature or at a high temperature and pressure?

"[Objected to, for the reason that the publication referred to in the question is not referred to in defendants' answer; and that the production of the book is the proper evidence of what it contains or does not contain, and that the question calls for negative testimony.]

"A. I have examined J. Frederick Daneill's Introduction to the Study of Chemical Philosophy, London, 1843. It is by the same author as quoted in Exhibit 9. The only notices contained in that work of methods of decomposing fats are on pages 616 and 617. On page 616 it mentions that glycer-

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"[Objected to, for the reason that the publication referred to in the question is not referred to in defendants' answer; and that the production of the book is the proper evidence of what it contains or does not contain, and that the question calls for negative testimony.]

"A. I have examined J. Frederick Daneill's Introduction to the Study of Chemical Philosophy, London, 1843. It is by the same author as quoted in Exhibit 9. The only notices contained in that work of methods of decomposing fats are on pages 616 and 617. On page 616 it mentions that glycer-

ine may be separated from oil or fat by boiling the latter with a solution of caustic alkali or oxyde of lead, whereby soaps or plasters are formed and the glycerine separated. On pages 616 and 617 the stearic, margaric, and oleic acids are stated to be obtained by saponifying stearine, margarine, and oleine with caustic potash, and then decomposing the stearate, margarate, and oleate of patassa by muriatic acid. No other method of obtaining fat acids is mentioned. Daniell's work contains no mention of the process for decomposing fats by the action of water, either at common temperature or at a high temperature and pressure."

It is to be noted that no mention is made in the exhibit of *any glycerine* being found *in the water*, nor of any fat acid existing in the oil.

When Dr. Vanderweyde was asked if he could explain why a specimen of the same oil and water, which had been kept in a covered glass vessel during the same length of time, was not also decomposed, (Rec., 87, p. 402, ×q. 73,) he replies: "Very easily. In the glass vessel, oil and water were at perfect rest. In the barometer they were never at rest, by the daily varying pressure of the atmosphere and the consequent oscillation of the liquids. In the glass vessel the formation of the emulsion was not promoted by continuous motion, as was the case in the barometer."

Now, the average daily oscillation of the barometer is less than $\frac{1}{2}$ inch of mercury, equivalent to 7 inches of water; and as the area of the barometer tube is stated to be $\frac{1}{260}$ of the area of the cistern, this would cause an oscillation of the liquids in the cistern of about $\frac{1}{35}$ inch in twenty-four hours, or $\frac{1}{840}$ inch in an hour, or $\frac{1}{50400}$ of an inch in a minute—a motion which would defy the most delicate micrometer and microscope to detect—and less than the thousandth part of the tremor that would be communicated to a glass of water standing upon a table by a person walking across the floor.

Professor Wayne, of Cincinnati, appellant's witness, (Rec., 340, p. 478,) also testifies that this exhibit announces the fact that fat can be decomposed by water at the common temperatures of the air; but as it appears from his answers to ×qq. 190 to 201, (Rec., 340, p. 480,) that he supposed that some unknown degree of heat was applied to the barometer, and that steam might have been present above the oil, and that he had not the least idea as to the length of time involved, it is evident that his testimony has been given with more zeal than knowledge or discretion.

Wayne admits on cross-examination, however, that fat acid could not have existed in the *copper* boiler of Daniell. (Rec., 340, p. 479.)

"×Q. 181. Will fat acids corrode metallic surfaces, (copper, iron, and brass,) when kept a long time in contact with them in the air?

"A. They will slowly—more rapidly, if heated.

"×Q. 182. If, therefore, the oil in Exhibit 9 had been converted into free fat acids, any metallic surfaces of brass, iron, or copper, which had been in contact therewith during a long time, would have been corroded, would they not?

"A. The word 'corrosion' here used, to some, would imply a rapid and destructive action upon the metals named, (I mention this in explantion of the use of the term.) Such rapid corrosion would not take place with the fat acids. They certainly would act upon the metals corrosively, but very slowly; and that they did thus act would be shown more clearly from the color of the fat acids than from any corrosion evident upon the metallic vessel containing them.

"×Q. 183. Do you wish to be understood as asserting, as a chemist, that a surface of copper or brass would remain 'bright,' and 'with no signs of metallic corrosion in any part,' after remaining for several months in the air, at common temperatures, in contact with the free fat acids of castor oil?

"A. The case is a supposed one. I would say that a flat surface of copper or brass could be thus exposed for several months, covered with merely a film of fat acids, or as much as would remain on the surface of the metal—that in the time

mentioned a solution or corrosion of the metal on its whole surface thus exposed would take place."

Wayne also explains what the mucilaginous substance was. (Rec. No. 340, p. 479.)

×Q. 198. Do you understand the "mucilaginous-looking substance" mentioned in Exhibit 9 to have been the free fat acids of castor oil?

A. I do not. (Rec. 340, p. 479.

×Q. 199. What do you understand said "mucilaginous-looking substance" to have been?

A. It may have been albuminous matter separated from the oil, which separation will take place when castor oil and water are mixed together. Castor oil thus treated will become slowly rancid, and will increase in rancidity by time. This mucilaginous matter will separate and form a layer between the oil and water. (Rec. 340, p. 31.)

MANNER IN WHICH APPELLANT TRIED TILGHMAN'S COIL.

F. Verdin, appellant's partner, had charge of all coil experiments, and he thus testifies:

"×Q. 62. Had you the chief direction and management of all the experiments with the coil apparatus made in New York and Cincinnati?

"A. I had here in New York, to a certain extent, and my nephew, who is now deceased, to the other extent; and in Cincinnati I did not want to have anything to do with it whatever. I wanted the manufacturers of Cincinnati to operate with it themselves, so that they could judge for themselves the value of the process. I also, at their request, took the chief management of it in Cincinnati. (Rec. 340, p. 398.)

"×Q. 52. Was the rate of discharge from the exit-valve more regular when the coil was at the heat of melting tin or bismuth than when it was at the heat of melting lead?

"A. It was more regular at the melting point of tin.

"×Q. 53. The explosive discharges you have spoken of occurred at the melting point of lead, did they not?

"A. They occurred between the melting point of bismuth and lead.

"×Q. 54. What was the reason of this difference, do you suppose?

"A. I suppose by putting a *much heavier weight on the lever* of the valve it might prevent these explosions.

"×Q. 55. In these explosions a large quantity of the mixture was thrown out at one time, was it not?

"A. It was.

"×Q. 56. And the tubes were then partly empty of the mixture, and consequently so far filled with steam, were they not?

"A. I suppose they were.

"×Q. 57. In your experiments, was the same weight used on the exit-valve at all the temperatures, from melting tin to melting lead?

"A. The same weight was used at all the melting points." (Rec. 340, p. 399.)

Perfectly understanding that the patent called for longer time at tin than at lead melting heat, he persistantly refuses to so try it.

"×Q 60. Did you not understand from the patent that at the temperature of melting tin a longer time would be required to produce decomposition than at the melting point of lead?

"A. *I did understand that.* The time is not mentioned in the patent. It only speaks of ten minutes.

"×Q. 61. In your experiments the rate of working of the pump was the same at all the temperatures used, from melting tin to melting lead, was it?

"A. It was always the same—so that it should take ten minutes to go through the coil. My aim was to complete the operation in ten minutes, as prescribed by the patent. (Rec. 340, p. 397.)

"×Q. 74. In your opinion, is not the proper regulation of the exit-valve the most important feature of the working of the coil apparatus?

"A. *I suppose it is, if it can be done;* and I wish that some one would show me how to do it." (Rec. 340, p. 399.)

The drawing of the patent shows him how to do it, by using a spring balance. He follows the drawing with minute accuracy in all the unimportant features, but the one he knows to be vital he alters. The spring closes the valve instantly after lifting, while the weight falls very slowly, as he himself remarks—

"The irregular action is caused by the great pressure on the valve when the valve opens once. It does *not shut fast enough*, and that caused the discharge to be greater than the supply, and leaves steam room in the pipe." (Rec. 340, p. 391.)

And yet this partner of the appellant, Florence Verdin, with the full knowledge not only of his bad result, but also *why* it was bad, and that the patent showed a spring, goes on using a weight which he finds too light, but never changes, and says he left it to the mechanic to calculate, and the mechanic left it to him; and so nobody did it. (F. Verdin's Testimony.)

"×Q. 58. Have you any direct personal knowledge of the amount of pressure produced in the tube by the weight used on the lever of the exit-valve?

"A. I had not. I left that to the mechanic who built the machine." (Rec. 87, p. 391.)

"William Thomas, sworn on part of defendant, says:

"Q. 1. What is your name, age, residence, and occupation?

"A. William Thomas; age, thirty-eight years; residence, New York City; am a machinist and engineer.

"Q. 2. Have you recently put up a coil apparatus for operating on fats? If so, state when and where, and describe the apparatus.

"A. I have, in Mr. Van Horn's shop, in Fifth street, between Avenue D and Lewis street, last week or the week before. It was a coil," &c. (Rec. 87, p. 190.)

"×76. Who loaded the safety-valve?

"A. *I cannot say.*

"×77. Would the steam, generated at the melting point of lead, have sufficient pressure to open that safety-valve as it was loaded?

"A. I don't consider it would be steam any more at the melting point of lead. I think it would be a gas.

"×78. Would the thing, whether it be gas or steam, generated at the melting point of lead, have sufficient pressure to open the exit-valve in the apparatus which you tried?

"A. *I didn't load the valve*, and therefore I cannot answer that question." (Wm. Thomas, Rec. 87, p. 195.)

"×88. Who superintended the apparatus which you made,

and which you saw tried yesterday at Mr. Mitchell's factory?

"A. I can't say that there was any particular one; all seemed to take a hand in it that were there.

"×39. Who all were there?

"A. There was myself, Mr. Verdin, Sr., and Mr. Verdin, Jr., and two Germans—one of the engineers in Mr. Mitchell's factory, and the other attends the fires; also Mr. Thain, Mr. Goddard, Mr. Mitchell. I don't know that Mr. Mitchell stopped through the whole. And there was one more gentleman.

"×40. What did you do?

"A. I was sometimes a taster and smeller; I also worked the force-pump sometimes, and went round the whole of it.

"×41. Can't you tell me who conducted the experiment?

"A. I really cannot. I have told you before it was a general thing. (Same witness, Rec. No. 87, p. 194.)

THE APPELLEE OFFERED TO SHOW COIL-APPARATUS PRACTICALLY AT WORK, TO APPELLANT, AND IT WAS DECLINED.

Just before the testimony had been closed in this case the appellant asked for the inspection of appellee's apparatus; it was declined on that account, but as soon as the court fixed a later day for hearing the case, the apparatus was tendered and refused.

"The defendant requests the opportunity of performing an experiment, or experiments, on the coil-apparatus used by the complainant in his experiments which have been testified to, at which the defendant may be present, to which he will attend as early as next week, after Monday, as may suit complainant's convenience, in Philadelphia.

"MARCH 24, 1864.

"Present, counsel for respective parties.

"In reply to the request made at the adjournment on the last day of taking testimony by the defendant for the use of the coil-apparatus to experiment with, Mr. Tilghman replies:

"That the coil-apparatus is very weighty and bulky, and was dismantled at the request of Professors Booth and Bridges, the day after the experiments therewith were tried by them, in order to enable them to examine its interior construction and dimensions; that to get the coil-apparatus

again in working order, and try new experiments, would require considerable time and delay the hearing; that the defendant neglected to make his request until the moment of adjournment on the day originally fixed for closing the testimony; that the complainant has, however, caused the same experiments to be repeated in a more portable apparatus, which he produces and marks Exhibit 'Digester," and now formally offers to experiment with it, and try any pertinent experiment in the presence of defendant, on Friday, March 25th, at any suitable place and hour which defendant will now indicate; it being understood also that such experiments tried for defendant are not to be permitted to delay the hearing."

To this offer of appellee, the appellant made no reply whatever:

"MAY 6TH, 1864.

"Counsel for defendant offers to repeat the experiments in the coil-apparatus and on the Scharling apparatus, in the presence of complainant, and make alterations therein to make it conform to complainant's patent, if any are necessary; it being understood that such experiments are to be made at a time which will give opportunity to give evidence in this cause in respect thereto. Also to repeat the experiments on the Scharling apparatus in complainant's presence.

"Mr. Harding replies, by giving in evidence the following offers, which is marked 'Exhibit, April 13, 1864,' together with the affidavit of service thereof on defendant's counsel, together with his reply, April 15, 1864; and further refers to his offer to repeat the complainant's experiments on the digester contained in the record on the date of March 24, 1864. And further adds that, as the complainant has a complete apparatus, constructed in accordance with his patent, the successful operation of *which he has proved by disinterested experts*, and has repeated the offer to exhibit to the defendants, he cannot see any reason why he should occupy time in altering the apparatus now at the defendant's works, especially since the time for closing testimony and the day of hearing will not leave time to re-open this matter." (Rec. No. 87, p. 74.)

APPELLEE'S EXHIBIT, APRIL 13, 1864.

"PHILADELPHIA, *April* 13, 1864.

"SIR: On the 5th inst. I mailed to you the notice of which

the following is a copy, requesting the favor of an answer within five days.

"For fear that you did not receive it, I now send this copy of my former note, requesting the favor of an answer accepting or declining my proposition within the five days after your receipt of this present notice, inasmuch as I have other engagements to which I wish to attend. I would also thank you to acknowledge the receipt of my former notice, if it was received by you.

"Very respectfully, yours,

"R. A. TILGHMAN.

"G. C. GODDARD, Esq., (*Sol. for Defts.*)
"17 *William Street, N. Y.*"

"APRIL 5, 1864.

"SIR: The only objection which complainant had to the repeating of his experiments on the coil-apparatus was the risk of delaying the hearing to the next term.

"As the court has ordered that the case shall still be heard this term, though at a later day, the complainant now offers to repeat the experiment tried by Professors Booth, Rogers, and Bridges, in the presence of the defendant; and requests the defendant to signify his acquiescence or refusal of this proposition within five days. If accepted, the complainant will at once have his apparatus put in order, and then appoint the earliest day which may be convenient to both parties for the defendant to visit complainant's laboratory in Philadelphia and see the process in action.

"Very truly, yours,

"R. A. TILGHMAN.

"G. C. GODDARD, Esq., (*Sol. for Defts.*)
"17 *William Street, N. Y.*"

"NEW YORK, *April* 15, 1864.

"DEAR SIR: Yours of the 13th is received, as was yours of the 4th or 5th, to which I think I made answer.

"After the use of your coil-apparatus by us was declined by you, we made arrangements which we hope will supersede the necessity of making experiments on yours. Should we change our minds, and desire to experiment on yours, we will advise you; *but at present we do not.*

"GEORGE C. GODDARD.

"Mr. R. A. TILGHMAN." (Rec. 87, p. 97.)

CHEVREUL'S PATENT, (ENTIRE,) EMBRACING EXHIBITS 18 AND AA.

Certificates of inventions. Paris. Vol. 41, pp. 392, 393.

"JANUARY 5, 1825.

"Certificate of invention for fifteen years to Messrs. Gay Lussac and Chevreul, of Paris, for the application of the stearic and margaric acids to illuminating purposes: * *

"We *saponify* the fatty bodies destined for illumination, or which we will allow to remain *in the state of soap*, either at the ordinary temperature of ebullition with the sole pressure of the atmosphere, or at a more elevated temperature with the pressure of several atmospheres. We have found that the *saponification* executed in the latter manner presents greater advantages over that which is commonly practiced with the sole pressure of the atmosphere.

"We separate the stearic and margaric acids from the oleic acid by the following processes: (Rec. 87, p. 244).

"1st. We decompose by water the soapy mass obtained by saponifying grease, tallow, &c., *by an alkali*; the water dissolves the oleate to the exclusion of the great mass of the stearic and margaric acids, which are left behind in the state of supersalts (sursels.) These last are then decomposed, as well as the oleate, by hydrochloric or any other acid.

"2d. We can also decompose the *soapy mass* at once by hydrochloric acid. We treat *the fat acids resulting from the decomposition:* 1st, by pressure, either hot or cold—the oleic acid flows out and leaves the stearic and margaric acids; 2d, by alcohol, which at low temperatures dissolves the oleic in preference to the two other acids.

"We treat the soap successively: 1st, by cold alcohol, which dissolves much oleate; 2d, by boiling alcohol, which dissolves all the salts formed by the fat acids. As it cools, the stearic and margaric acids are precipitated in the state of salts, and the oleic acid remains in solution. We then separate the alkali combined with these acids by means of any other acids whatever." (Rec. 87, p. 77.)

Exhibit No. 5.

"Encyclopedia Roret, published in Paris, 1849, pages 110, 111, 113, 114, and 115.

Translation.

"The milk of lime having been poured into the tub, along

with the melted tallow, and the current of steam being continued, the temperature of the mixture rises, and the combination takes place gradually.

"To hasten it, and render it more complete, it is proper to stir the mass thoroughly. This stirring is really of great importance, for not only does it accelerate and render more complete the combination of the lime with the fat acids, but it also permits us to diminish the proportion of this base, and the quantity of sulphuric acid used to saturate it.

"'We can get an idea,' says M. Dumas, 'of the saving which would result from an improved saponification, in the single item of sulphuric acid.'

"In reality, the tallow employed containing only 88 per cent. of fat acids, we find, by calculation, that 100 kilos. of this tallow would require $9\frac{35}{100}$ kilos. of lime to saponify it. But in most factories they employ more than 15 kilos. There is then, for every 100 kilos. of tallow, at least 6 kilos. of lime, which it is necessary to saturate in pure waste, by 10 or 11 kilos. of sulphuric acid at 66°. We insist, then, on this point, and repeat that a powerful stirring would enable us to diminish this loss."

After all, the manufacturers alone can judge of this question, and decide whether, in their position, the cost of establishing and maintaining the motive power necessary for this prolonged stirring is greater than the loss they undergo by the saturation of the excess of lime. At all events, it is evident that the process of saponification by lime, as now generally practiced, is not sufficiently economical, and that it would be desirable to seek some other method, by means of which the quantity of caustic alkali used to saponify the fatty matter could *be reduced more nearly to the proportion indicated by theory.*

* * * * * * *

Another useful observation is presented, viz: That the

saponification of fats by lime can scarcely be executed, rapidly and completely, except under a pressure greater than that of the atmosphere. It was believed for a long time that saponification by lime could only be effected in closed boilers, and, although it has since been ascertained that increased pressure, and consequently increased temperature, are not indispensable for this saponification; it is quite possible that in returning to the former opinion, we may effect an important diminution in the proportion of lime required for a given weight of fat.

This idea, however, is not novel; for it was announced in the patent of Gay Lussac & Chevreul, and has been repeatedly taken up by manufacturers, AND WE DO NOT KNOW WHY IT HAS BEEN ABANDONED.

We will quote, for example, the process of saponifying fats patented to Milly & Motard, in 1834, and described in Vol. LII, page 505, of the "Brevets d'Invention," from which the following is extracted: "The boiler employed by the inventors is of a cylindrical form, its upper part terminating in a man-hole, hermetically closed by a bolted cover. This cover has in its centre a stuffing-box, through which passes a stirring-rod, with a cross-piece of wood on its lower end. Another hole in the cover is for a tube, which plunges some six inches into the boiler, and which is to contain a thermometer.

"The boiler is heated by a furnace of usual construction.

"Water is first run into the boiler, equal about to twice the weight of fat to be saponified; the fat is then introduced, and when it is melted, milk of lime, sufficient for the saponification of the fat is run over the liquid mass.

"The boiler is then closed, and the liquid stirred at short intervals, by raising and lowering the stirring-rod or plunger.

"This operation is continued until the thermometer marks

Appellee's Declaration to U. S. Patent Office, 1854.

In the correspondence with the Patent Office, dated August 7, 1854, *two* months before his patent was granted, (Appellee's Exhibit "A," Rec. 340, p. 608,) appellee's agent writes:

"In his specification the inventor has given a drawing and description of an apparatus in which the process may be conveniently carried on, but he expressly states that 'he does not intend to claim said apparatus as forming any part of his invention.' In fact, the *form of apparatus* in which the materials may be treated according to the invention *may be indefinitely varied* to suit the ideas of the constructor, the only essential point being that it shall be capable of withstanding the necessary heat and pressure."

277° Fahr., (136° Centigrade.) As the whole mass becomes stiff after a certain time, agitation is no longer practicable; the operation is left to itself, and ceases with the diminution of the temperature. When the thermometer only shows 212° Fahr., the boiler is opened, and emptied by the man-hole as soon as it is sufficiently cooled."

TILGHMAN'S ENGLISH PATENT, PROVISIONAL SPECIFICATION—EXHIBIT Q.

"Provisional Specification left by the said Richard Albert Tilghman at the office of the Commissioners of Patents, with his Petition, on the 9th January, 1854.

"The first part of my invention consists in a new method of obtaining free fat acids and solution of glycerine from animal and vegetable fatty and oily bodies which have glycerine as their base. Two processes are now practiced for this purpose, one called the saponification process, making use first of lime to decompose the fat, (forming a lime soap,) and then of some strong acid to neutralize and remove the lime, leaving the fat acids in a free state.

"In the other process the fat is heated with concentrated sulphuric acid, which so acts upon or combines with the glycerine of the fat, that boiling with water removes both of them, leaving the fat acids in a free state.

"Now, my invention consists in exposing the aforesaid fats and oils to the action of water *at a high temperature and pressure*, the *effect of which* is to cause the combination of the water with the elements of the neutral fats, so as to produce at the same time free fat acids and solution of glycerine. Those fats, which, like palm-oil, are highly colored, are also to some extent bleached by the process, and the strong smelling oils are more or less deodorized. The operation is per-

formed in a *continuous* manner by pumping an intimate mixture of the fat and water through a very strong metallic vessel heated to the requisite degree. From it the mixture (now changed into free fat acids and solution of glycerine) escapes through a safety-valve so heavily loaded as not to open by the mere pressure of the steam. The solution of glycerine settles from the hot fat acids, and may be purified as usual. The fat acids may be used for making soap and candles at once, or bleached by any of the ordinary methods, or may be distilled with hot steam in the usual manner.

"The second part of my invention relates to the manufacture of soap."

SPECIFICATION

OF APPELLEE'S PATENT.

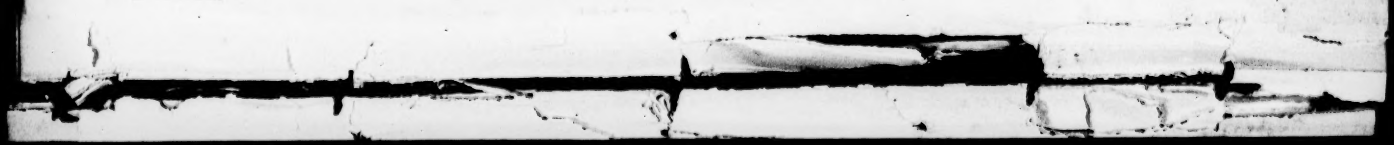
Granted October 3, 1854: *antedated to January* 9, 1854.

The schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN.

Be it known that I, Richard Albert Tilghman, of Philadelphia, have invented a new and improved *mode of treating fatty and oily bodies*, and I hereby declare that the following is a full and exact description thereof.

My invention consists of *a process* for producing [5] free fat acids and *solution* of glycerine from those fatty and oily bodies of animal and vegetable origin which contain glycerine as their base. For this purpose, I subject these fatty or oily bodies to the action of *water at a high temperature and pressure*, so as to cause the elements of those bodies [10] to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine. I mix the fatty



body to be operated upon with from to a third to a half of its bulk of water, and the mixture may be placed in *any convenient vessel* in which it can be heated to the melting [15] point of lead, until the operation is complete. The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

The process may be performed more rapidly and [20] also *continuously* by causing the mixture of fatty matter and water to pass through a tube or continuous channel, heated to the temperature already mentioned; the requisite pressure for preventing the conversion of water into steam being applied during the process, and this, I believe, is the [25] best mode of carrying my invention into effect.

In the drawing hereunto annexed are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention. [30]

Fig. 1 of the said drawing is a vertical section of this apparatus, and fig. 2 shows the various parts of the apparatus in horizontal section: similar parts in these figures being marked with similar letters of reference.

I place the fat or oil in a fluid state in the vessel [35] *a*, with from one-third to one-half its bulk of warm water; the disc or piston *b*, perforated with numerous small holes, being kept in rapid motion, up and down in the vessel *a*, causes the fat, or oil and water, to form an emulsion, or intimate mechanical mixture. A force pump, *c*, like [40] those in common use for hydraulic presses, then drives the mixture through a long coil of very strong iron tube, *d*, *d*, *d*, *d*, which, being placed in the furnace *e*, *e*, is heated by a fire, *f*, to about the temperature of melting lead. From the exit end *g* of the heating tubes *d*, *d*, the mixture, which [45]

has then become converted into free fat acids and solution of glycerine, passes on through another coiled iron tube, *h*, *h*, *h*, immersed in water, by which it is cooled down from its high temperature to below 212° Fahrenheit, after which it makes its escape through the exit valve *i*, into the receiving [50] vessel.

The iron tubes I have employed, and found to be convenient for this purpose, are about one inch external diameter and about half an inch internal diameter, being such [55] as are in common use for Perkins' hot-water apparatus. The ends of the tubes are joined together by welding to make the requisite length, but where welding is not practicable, I employ the kind of joints used for Perkins' hot-water apparatus, which are now well known. The heating tube, *d*, *d*, *d*, [60] is coiled several times backwards and forwards, so as to arrange a considerable length of tube in a moderate space. The different coils of the tube are kept about a quarter of an inch apart from each other, and the interval between them is filled up solid with cast iron, which also covers [65] the outer coils, or rows of tubes to the thickness of half or three-quarters of an inch, as shown in fig. 2. This casing of metal insures a considerable uniformity of temperature in the different parts of the coil, adding also to its strength, and protecting it from injury by the fire. [70]

The exit valve, *i*, is so loaded, that when the heating tubes *d*, *d*, *d*, are at the desired working temperature, and the pump, *e*, is not in action, it will not be opened by the internal pressure produced by the application of heat to the mixture; and, therefore, when the pump, *e*, is not in action, nothing [75] escapes from the valve *i*, if the temperature be not too high. But when the pump forces fresh mixture into one end, *j*, of the heating tubes, *d*, *d*, *d*, the exit valve, *i*, is thereby forced open to allow an equal amount of the mixture, which has

been operated upon, to escape out of the cooling [80] tubes, *h*, *h*, at the other end of the apparatus. No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture. For this purpose, whenever it may be required, the speed of the pump should be increased, so that the current through the [85] tubes may be made sufficiently rapid to carry out with it any air remaining in them.

Although the decomposition of the neutral fats by water takes place with great quickness at the proper heat, yet I prefer that the pump, *c*, should be worked at such a [90] rate in proportion to the length or capacity of the heating tubes, *d*, *d*, *d*, that the mixture, while flowing through them, should be maintained at the desired temperature for ten minutes before it passes into the refrigerator or cooling parts, *h*, *h*, of the apparatus. [95]

The melting point of lead has been mentioned as the proper heat to be used in this operation, *because it has been found to give good results.* But the change of fatty matters into fat acid and glycerine takes place with some materials (such as palm oil) at, *or below*, the melting point of bismuth, yet [100] the heat has been carried considerably above the melting point of lead without any apparent injury, *and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat, and gradually increasing it, the temperature giving products most suit-* [105] *able to the intended application of the fatty body employed can easily be determined.*

To indicate the temperature of the tubes, d, d, d, I have found *the successive melting of metals and other substances of different and known degrees of fusibility to be convenient in prac-* [110] *tice;* several holes, half an inch in diameter and two or three inches deep, are bored into the solid parts of the castings

surrounding the tubes, each hole being charged with a different substance. *The series I have used consist of tin, melting about* 440° *F.; bismuth, at about* 510° *F.; lead, at* [115] *about* 612° *F.; and nitrate of potash, at about* 660° *F.* A straight piece of iron wire, passing through the side of the furnace to the bottom of each of the holes, enables the workmen to feel which of the substances are melted, and to regulate the fire accordingly. It is important, for the [120] quickness and perfection of the decomposition, that the oil and water, during their entire passage through the heating tubes, should remain in the same state of intimate mixture in which they enter them. I, therefore, prefer to place the series of heating tubes in a vertical position, so [125] that any partial separation which may take place, while the liquids pass up one tube, may be counteracted as they pass down the next. I believe that it will be found useful to fix at intervals, in the heating tubes, diaphragms pierced with numerous small holes, so that liquids, being forced [130] through these obstructions with great velocity, may be thoroughly mixed together.

I deem it prudent to test the strength of the apparatus by a pressure of ten thousand pounds to the square inch, before taking it into use; but I believe that the working [135] pressure necessary, in using the heat I have mentioned, will not be found to exceed two thousand pounds to the square inch.

When it is desired to diminish the contact of the liquids with iron, the tubes or channels of the apparatus [140] may be lined with copper. The hot mixture of fat acids and solution of glycerine which escapes from the exit valve of the apparatus separates by subsidence. The fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means. [145]

The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soaps, and applied to various purposes, according to their quality; and, when desired, they may also be first [150] bleached by chemical agents, or purified by distillation in a current of steam or in a vacuum, as is now well understood. I prefer that the fatty bodies should be previously deprived, as far as practicable, of such impurities as would cause the discoloration of the fat acids produced; but when the [155] fat acids are to be finally purified by distillation, this preliminary purification is of less importance.

When the sulphuric acid, nitrous fumes, or other corrosive agent shall have been used for purifying, hardening, or otherwise preparing the fatty body to be operated [160] upon, I take care that all traces of it shall be washed out or neutralized before passing it through the apparatus.

Some fatty bodies (particularly when impure) generate during the process a portion of acetic or other soluble acid, which might tend to injure the iron tubes; [165] in such cases I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes.

Having now described the nature of my said invention, and the manner of performing the same, I hereby [170] declare *that I claim, as of my invention, the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure.*

R. A. Tilghman.

Witnesses:

James McCurley,

John R. Darker,

Consulate of the United States, London.

Specification of Wright & Fouche's Patent.
January 25, 1859.

[This is the patent under which appellant swears he works. (See Answer, p. 9, Rec. 87.)]

The schedule referred to in these Letters Patent and making part of the same.

To all to whom it may concern:

Be it known that we, Robert Alfred Wright, civil engineer, and Louis Jules Fouche, steam-boiler maker, of Paris, in the empire of France, have invented "a new apparatus, destined to produced chemical decompositions by means of superheated steam and water;" and we do hereby de- [5] clare that the following is a full, clear, and exact description of the same, reference being had to the annexed sheet of drawings, making a part of the same.

The apparatus, which is the object of the present patent to secure, is susceptible of several industrial appli- [10] cations; but as it is chiefly intended for the *decomposition of fatty substances into fatty acids and glycerine*, we will describe it as applied to that purpose.

This invention is represented in the annexed drawings, where— [15]

Fig. 1 shows the elevation of the apparatus complete.

Fig. 2 the vertical section of a part of the apparatus modified.

Fig. 3 the vertical section of a part of the apparatus in a modified form. [20]

Lastly, Fig. 4 the horizontal section of the same modified apparatus.

The dimensions of the appar'tus may vary with the various purposes to which it may be applied.

In these figures the same letters indicate the same [25] parts when they recur.

A is a metal (iron or copper) boiler, of any form whatever, placed in a furnace, in order to be heated by a naked fire; this boiler has sides sufficiently strong to resist a pressure of from ten to twenty atmospheres; it is of a variable [30] capacity, according to the requirements of the manufacture, and it may have its interior lined with lead, or by any other metal which will not be attacked by the fatty bodies which are to be introduced and produced therein; *b*, hearth; *c*, ash-pit; *d*, dipping-pipe, furnished with a cock to empty [35] the apparatus by pressure; *e*, man-hole, serving for cleaning the cylindrical vessel *a*, and for the introduction of substances, if required; *f*, metal tube (of iron or copper) connecting the bottom of the boiler *a* with the bottom of the cylinder *h*; *g*, metal tube of ascension, conducting [40] the superheated water from the boiler *a* to the upper part of cylinder *h*. This tube is terminated in the interior of the cylinder *h* by a rose jet, or, more simply, holes are made in the extremity, so as to distribute the water uniformly in the cylinder *h*, and to insure a molecular or finely sub- [45] divised contact between the superheated water and the substance submitted to the operation; *h*, iron or copper upper cylinder, which should, like boiler *a*, be able to resist a pressure of from ten to twenty atmospheres. The cylinder *h* receives the substances to be treated; *i*, funnel, fur- [50] nished with a tube and with a cock, serving for the introduction of the substances to be treated into the cylinder *h*; that is, when this substance is of such a nature as to be introduced through a small aperture; *k*, man-hole, serving for cleaning the cylinder *h*, and for the introduction of [55] substances to be treated which cannot pass through the funnel *i*; *l*, safety-valve; *m*, manometer or pressure-gauge, indi-

cating the pressure in the whole of the apparatus; *n n*, cocks serving to indicate the height and level of the substance and of the water in cylinder *h*; *o*, cock serving to empty [60] the cylinder when the operation is completed.

ACTION OF THE APPARATUS.

Supposing everything arranged as shown in the drawing, then, in order to decompose fatty substances into fatty acids and into glycerine, the boiler *a* is completely filled with water. The cylinder *h* is filled with water up to one third of its height, and it is then filled up to the level [65] of the upper cock with the fatty bodies to be decomposed. The introduction of the fatty bodies takes place, as we have said, either through the funnel *i* or by the man-hole *k*. The boiler *a* is then gradually heated till the pressure-gauge indicates a pressure of from *ten to twenty atmospheres*,* [70] according to the nature of the substances submitted to the operation, when the following takes place:

The superheated water in the boiler *a* acquires an ascending motion, on account of the difference in the temperature of the two capacities *a* and *h*. A current is thus cre- [75] ated, whence it results that the heated water in boiler *a* ascends through the tube *g* into the cylinder *h*, and, being forcibly driven out through the holes in the rose jet, passes through the fatty bodies and descends again through the tube *f* to the bottom of the boiler *a*, where it is [80] again warmed, in order to recommence its ascending motion, and so on.

When this operation has been thus continued during a length of time which may vary from five to eight hours, according to the nature of the fatty bodies operated [85]

*From 340° to 420° temperature.

on, and also according to the variation of pressure, (varying from ten to twenty atmospheres,) the fatty bodies are decomposed into glycerine, which remains dissolved in the water, and into fatty acids, which float in the cylinder *h*. The contents are now emptied out and separated from each [90] other at the same time.

In Figs. 2, 3, 4 we have represented modifications of the heating boiler *a*. Thus, in fig. 2, the boiler is heated by a continuous current of steam. For this purpose *p* is a double casing, receiving the steam; *r* and *q* are the enter- [95] ing and exit pipes.

This same apparatus, having a double casing, may be placed on a furnace with a naked fire, so as to form a water-bath at high temperature. It is furnished with a man-hole and safety-valve, not represented in the drawings. [100] In fig. 3 the water in the boiler *a* is heated by a worm, *s*, having one branch leading from any generator whatever, and returning to the same generator by the other branch. In Fig. 4 the water in boiler *a* is heated by a horizontal worm, *t*, having one branch coming from any suitable [105] generator, and returning to this same generator by the other branch.

In conclusion, we would remark, that *we are aware that, firstly, the decomposition of fatty bodies by water, under the influence of heat and of pressure, is a well-known scientific* [110] *fact.* "Water is substituted for the organic basis. It forms a perfect and fixed combination with the fatty acids, while the glycerine is dissolved in the excess of water." Secondly, that as this chemical action takes place under the influence of a weak affinity, it is necessary, in addition to the [115] above-named physical and chemical conditions, to insure a *perfect molecular agitation* of the whole mass; and that we wish it to be understood that what we wish to claim and establish

as of our invention consists of an apparatus wherein the water and the fatty maters are heated separately in two [120] different boilers. The first boiler is heated by the source of heat, while the second boiler is heated by the first boiler.

[Here follows diagram, marked p. 365.

In these boilers the agitation necessary for the *chemical action and combination is produced* by the pressure of [125] the *heated water in the first boiler. This water* circulates continuously from this first boiler to the second boiler, and from the *second boiler to the first*, in a continuous and self-acting or automatic manner, without interruption. The characteristics of our apparatus are, that it produces *agitation* by [130] *circulation alone*—a continuous and automatic circulation, produced by the pressure of water.

Lastly, our apparatus effects its chemical action in a continuous manner, without the aid of any manual or other assistance. [135]

Claims. Having described the nature of our invention and the manner in which the same is to be performed, we do not claim the application of *superheated water* for decomposing fatty bodies, nor the form of the apparatus above described, which may vary somewhat, according to condi- [140] tions and circumstances; but what we claim as our invention is, producing a continuous automatic circulation of highly-heated water, in a very finely divided state, through the bodies under treatment, by means of an apparatus constructed and employed substantially as herein shown and de- [145] scribed.

ROBERT A. WRIGHT,
L. FOUCHE.

1. GARDESSAL,
2. Z. MILLION,

Witnesses.

Note 2.

In Reply to Position taken at pages 86–87 of Appellant's Brief, as to Comparative Cost of Labor, Fuel, and Interest in Working by the old Lime Saponification Process and by the Appellant's present Process.

Appellant also testifies, that whereas, under the lime saponification process, he had saved and sold only 15,158 lbs. of glycerine in the ten years prior to 1860, he has since 1860, under his new process, saved and sold 708,733 lbs. of glycerine, or 46 times as much in $\frac{6}{10}$ of the time, or 76 times as much in an equal time. He also testifies, that appellee's licensees, who formerly threw away the glycerine water, now sell it at the rate of 20 cents for the crude glycerine water of each 100 lbs. of fat worked. These items therefore—13½ lbs. of lime, 27 lbs. of sulphuric acid, and 2 lbs. of fat, at their market value, and 20 cents for the glycerine from each 100 lbs. of fat worked, are the gross savings realized by defendant by his use of complainant's process.

In the use of the apparatus erected by appellee's licensees, the items of lime, acid, and fat are clear savings, and the cost and wear and tear of the apparatus are counterbalanced by other items of saving over the old process, viz: in labor and fuel, and in the greater certainty and perfection of the decomposition.

The saving of fuel is evident from the statement of appellant's witness, Ropes, that by the old process 6 to 7 hours' boiling was necessary to make the lime soap, which (weighing over 4 tons) had then to be shoveled over into another vessel and boiled with acid for 6 or 7 hours, making 12 to 14 hours' boiling in all. The mass of refuse sulphate of lime produced required to be repeatedly stirred and washed with water, and finally to be shoveled out and carted away.

Whereas, in appellee's process, either 5 hours' heat at 225 lbs. pressure, or 8 hours at 150 lbs., completed the operation, without any handling of the material whatever, and with a refuse product of only $\frac{1}{28}$ of the former quantity.

Appellee's licensee, Jones, (Rec. 87, p. 17, Q. 6, 21–53,) testifies, that with his apparatus, costing $8,000, he could decompose 150,000 lbs. of fat per week; the charges upon this, (at Mr. F. Verdin's estimate,) for interest and insurance, (9 per cent.,) and for wear and tear, (10 per cent.,) would amount to 20.3 cents per 1,000 lbs. of fat decomposed.

"×155. What do you estimate the expense of labor and fuel in converting a thousand pounds of fat into fat acids and glycerine by this old process?

"A. I have not made any estimate.

"×156. How does it compare in these items with the process you now use?

"A. The expense is greater." (Rec. 78, p. 128.)

"×265. Please state whether you are aware how much coal is consumed per week in working the four digesters at your factory, when decomposing at the rate of twelve charges each per week.

"A. I think about six tons, but I am not certain as to the exact quantity.

"×266. Do you think that this amount is greater or less than the amount consumed under the old process of lime saponification for the same amount of fat decomposed?

"A. I think it is somewhat less." (Rec. 78, p. 140.)

Mr. F. Verdin has made another statement of the cost of all items of expense in the Wright & Foucé apparatus, as compared with those in the lime saponification, (Rec. 87, pp. 343–344;) omitting the lime, acid, and fat saved, which are to be valued at their market price when saved, his estimate is as follows:

Wright & Fouché Apparatus to work 8,000 lbs. fat per day.		*Lime Saponification Process to work 8,000 lbs. per day.*	
Interest and insurance on cost of 6 sets of digesters, $17,690 50	$5 32	Interest and insurance on cost of apparatus, $1,483 34	$ 55
Wear and tear on digesters	5 90	Wear and tear on apparatus	61
Labor	11 00	Labor	10 00
Fuel	8 00	Fuel	7 00
Rent	1 66	Rent—not charged.	
100 lbs. acid, at 3 cents	3 00	Acid—none charged beyond that necessary for lime use.	
Interest on cost of patent	4 66		
Working expenses, W. & F	$39 54	Working expenses	$18 16
Working expenses, lime saponification	18 16		
Extra working expenses, W. & F	$21 38	Equal to $2 67 per 1,000 lbs. fat worked.	

"This sum, $2 67 per 1,000 lbs. fat worked, is therefore the maximum that could be claimed by appellant as the cost of working the Wright & Fouché apparatus, when giving testimony in his own case, and naturally endeavoring to reduce the estimate of his profits as much as possible. The difference between this sum and the market price of the lime, acid and fat saved on each 1,000 lbs. of fat worked will be the *net saving* realized by him, according to his own showing, by his working of appellee's process in the Wright & Fouché apparatus.

"And as the Wright & Fouché apparatus is shown to be more expensive in first cost, in wear and tear, and in fuel and labor, than the machinery used by appellee's licensees and free to the public, it is clear that instead of a profit being realized by the Wright & Fouché apparatus, considered as an apparatus, and as compared with other apparatuses free to the public, there is really a loss. If the Wright & Fouché apparatus costs more to buy, to keep in repair, and to work, than

other machines in actual operation and free to the public, the appellant, by using it, has diminished and thrown away a part of the saving or profit he would otherwise have realized by using appellee's process in machinery, free to him and the public to use.

"Several of the items of expense above, charged by Mr. Verdin, are evidently much exaggerated. He states that six sets of apparatus, costing $17,690, are necessary to work 8,000 lbs. per day. Whereas appellant's superintendent, J. P. Verdin, (Rec. 81, pp. 131–216,) states that each apparatus works a charge of 1,150 lbs., and works 12 charges per week, so that four sets of apparatus would suffice to work 9,200 lbs. per day, and the charges for interest, insurance, wear and tear, ought consequently to be reduced by one third.

Again, the same witness states, (Rec. 87, p. 128, Q. 154, also p. 140, Q. 265,) that the fuel and labor in the Wright & Fouché apparatus were less than in the lime saponification process, whereas Mr. F. Verdin makes them greater. Again, the item of rent is charged to one process and not to the other; and the interest on cost of the Wright & Fouché patent seems not a legitimate offset as against appellee, upon whom that patent has been decided to be an infringement, and where it appears that other machinery free to the public is cheaper and better.

If these corrections are made in Mr. F. Verdin's calculation, the extra working expenses for 8,000 lbs. in the Wright & Fouché apparatus, as compared with lime saponification, would be reduced to $10 73 or $1 34 per 1,000 lbs. of fat worked.

But we have another estimate from Mr. F. Verdin, made for his own use in 1860, when contemplating the purchase of the Wright & Fouché patent, and under every inducement to form a correct calculation.

He says (Rec. 87, p. 228, Q. 29) that he then estimated the net saving of the process at ¾ of a cent per pound. Now, taking the articles saved at their market price in December, 1860, as given by Mr. Mitchell, (Rec. 87, p. 253,)

We have 14 lbs. lime, at .488 cents	6.8
28 lbs. acid, at 2 cents	56.
2 lbs. fat, at 9¼ cents	18.5
Gross saving per 100 lbs	81.3
Net saving per 100 lbs., by F. Verdin's statement	75.
Extra cost of working apparatus per 100 lbs	6.3

Making 63 cents per 1,000 lbs. fat, as the extra cost of working the Wright & Fouché apparatus. Mr. Mitchell testifies, (Rec. 87, p. 253,) that in 1860 he sold no glycerine, and therefore it is not taken into the account.

We have, therefore, three different estimates made by appellant's partner, F. Verdin, of the extra cost of working the Wright & Fouché apparatus, as compared with the lime saponification: 1. That made for his own use in 1860, amounting to 63 cents per 1,000 lbs. of fat worked. 2. That made by him in 1867, but corrected by his own statements and those of his superintendent in 1864, making it $1 31 per 1,000 lbs. fat worked. 3. That made by him in 1867, when testifying, with the express view of reducing his profits to a minimum, making it $2 67 per 1,000 lbs. of fat worked. If this court shall decide that either of these sums should be allowed, it can be deducted from the gross value of lime, acid, and fat saved on each 1,000 lbs. of fat worked, and to such result the saving of glycerine can be added.

A calculation of the net saving, according to each basis, is here annexed;

In year ending July.	Quantity of fat worked.	Gross value of lime, acid, and fat saved.	Working expenses per 1000 lbs. 63 cts.	Net saving.	Working expenses per 1000 lbs. $1.31.	Net saving.	Working expenses per 1000 lbs. $2.67.	Net saving.
	Lbs.							
1861.....	1,165,745	$8,996.86	$734.41	$8,262.45	$1,527.12	$6,469.74	$3,112.43	$5,884.43
1862.....	1,502,316	11,063.28	946.45	10,116.83	1,968.03	9,095.25	4,011 18	7,052.10
1863.....	1,050,426	8,718.84	661.76	8,057.08	1,376.05	7,342.79	2,804 63	5,914.21
1864.....	1,395,142	14,556.26	878.93	13,677.33	1,827.63	12,728 63	3,725.02	10,831.24
1865.....	1,993,051	33,993.58	1,255.62	32,737.96	2,612.89	31.380.69	5,321.44	27,672.14
1866.....	1,613,263	26,254.43	1,016.35	25,238.08	2,113.37	24.141.06	4,307.41	21.947.02
1867.....	2,001,162	28,344.58	1,260.73	27,083.85	2,621.52	25,723.06	5,343.10	23,001.48
Jan. 9. 1868	781.787	8,096.95	492.52	7,604.43	1,024.14	9,072.81	2,087.47	6,009.48

Interest on the saving of each year, if allowed, should be added. The profit claimed as derived from the glycerine, 20 cents on each 100 pounds of fat worked, is less than what is received by appellee's licensees in Cincinnati, (according to appellant's testimony,) and is only about one fifth of the gross proceeds of appellant's sales of glycerine. (Rec. 87, p. 253.)

The whole of appellant's argument below was based upon the assumption that the appellee's patent is to be confined to the working of the process in the form of vessel or machinery described in the specification, and that all working of the process in any other form of machinery is something different from and outside of appellee's patent. His principal point now is, "Has the appellant realized, or could he have realized, a profit by the use of the process and *means described in appellee's patent?* The difficulty in the present case arises from the fact that the *means described in appellee's patent* are utterly worthless and impracticable." His other point is, "The process claimed in appellee's patent, *in either of the modes described*, cannot be worked in competition with the processes known and used before his alleged invention."

He has continued through many pages to argue as to the want of evidence that any profit has been made by the working of the coil-apparatus in England or France. We rested upon the decision of the court, that the thing pat-

ented is *the process* of making fat acids and glycerine from fat, by the action of water at a high temperature and pressure, *which process* may be carried out in any vessel adapted for such use, and that the apparatus described forms no part of the patent, and that the process could be carried into practical effect by the apparatus described. Appellee's position is, that he and his licensees, as part of the public, were at liberty to use, for the purpose of working his invention, any and all of the means and appliances, vessels and machinery, known and in common use in the arts at the date of his patent. And that, in using such public machinery to work his patented invention, he is working it by the "means contemplated in the patent," inasmuch as the existing state of human knowledge and the arts is to be taken as the basis of this and of every patent, and is to be understood as being referred to, as distinctly as if expressly mentioned in the specification.

A patentee need not expressly claim the right to use a common steam engine to drive his machinery, or to use coal to heat his furnaces. He has a right to use everything that the public can freely use, and his own invention in addition thereto. Now, the testimony shows that appellee, from the very beginning, intended to use, for the purpose of working his process, any and all kinds of vessels and machinery known to the arts and suitable for such use.

It is proved from the letter of appellee, dated July 20, 1857, which was called for and put in evidence, (Appellant, Rec. 87, p. 406,) that there was at that date in practical operation in London, at the works of Price & Co., appellee's licensees, a common iron boiler, lined with copper, 30 feet by 32 inches in diameter, decomposing charges of 2½ tons of palm-oil, perfectly, into fat acids and glycerine, by the action of water, at a temperature and pressure of 220 to 225 pounds

per square inch, in 4½ hours. This letter also states that agitation and mixture of the fat and water, by injection of free steam, was contemplated, and would hasten the decomposition.

It is also in proof that appellee put up an apparatus in Philadelphia in 1859, and another in Cincinnati in 1860, both precise copies of old well-known machines used in this same art, and that in both the process has been successfully worked, in one for over two years, and in the other for nine years, and up to this day.

In 1862 appellee put up for C. T. Jones, in Cincinnati, another form of apparatus, also well known and used in the arts, and in this the process has been steadily and successfully worked up to this day. Since that time other similar apparatuses have been put up and worked in Cincinnati, Louisville, St. Louis, and New York, and appellant, Mr. Mitchell, testifies there were, to his knowledge, in 1867, ten factories in the United States working under license from appellee, and not one, except himself, working the water process without license from appellee.

In order of date, therefore, it appears that in—

August, 1854, appellee states that "the form of apparatus may be indefinitely varied."

October, 1854, appellee states that the "apparatus described is no part of his patent."

July, 1857, an old form of apparatus is in practical use in London, on charges of 2½ tons each.

September, 1859, an old form of apparatus is in practical use in Philadelphia.

January, 1860, a similar apparatus is in practical use in Cincinnati.

1862, a different apparatus, but also old and well known, is in use in Cincinnati, on charges of 6,000 pounds.

1867, ten factories in the United States working the process under appellee's license, and no one except appellant working it without his license.

Is it any answer to this mass of direct proof, to show that the process has not been worked, on a manufacturing scale, in some one particular form or apparatus? We claim that *the process*, carried on in any vessel whatever, is still the exclusive property of the appellee. If the machinery described in the patent is "capable of carrying the process into practical effect," its importance will cease there.

The appellant has no more right to select its working or not working on a manufacturing scale as the measure of profit of *the process*, than to select any other of the infinite number of machines that could be used under the decision of the court.

In fact, the question of profit of *the process* is much simplified by the fact that no peculiar machinery is claimed in the patent, and that the machinery actually used for working the process is *public machinery*, not trammeled or complicated with patent or private rights, but free to every one to use.

"Suppose, for instance, that appellee had claimed the coil machinery as a distinct part of his invention, and that his licensees had realized certain savings or profits by working the process in this patent machinery, and in no other, and that appellant, using the patented process, but not the patented machinery, had been ordered to account for the profits of his infringement. Appellant would then naturally have contended that all the profits of appellee's licensees arose from their use of the patent machinery which he did not use, and that all his own profits in like manner arose from his own peculiar machinery, and not from the patented process. The court would then have had to distinguish between the profits derived from the patent process and those derived from the

patent machinery, and would have had no clear method of doing so.

As the case actually stands, however, the savings made by appellee's licensees are due solely to the *use of the process*, and not to the use of any peculiar machinery; and this is precisely the kind and amount of saving or profit that we claim against defendant, viz: such as have been derived from the process as distinct from the machinery in which it is worked.

Appellant has offered before the master a quantity of testimony intended to show that the coil-apparatus, when tried in Paris, and under direction of complainant or his agents, failed to come into manufacturing use, and that when tried by appellant in New York and Cincinnati, it destroyed part of the glycerine and gave products smelling of acroline.

Appellant's counsel, in argument, having coolly and boldly assumed the position that the coil-apparatus is the only one in which the process can be carried out according to the patent, and that to show that the coil-apparatus is nowhere worked on a manufacturing scale, is equivalent to showing that *the process* is not worked on a manufacturing scale, and that no profit is shown to be realized from it.

REPLY TO STATEMENT THAT THE GLYCERINE SAVED IS CHARGED AT THE MARKET PRICE. (See Mr. Evarts' Brief, p. 12.)

The glycerine is charged at only 20 cents on each 100 lb of fat worked, and is only about one fifth of the gross proceeds of appellant's sales of glycerine.

NOTE TO P. 118.—EXTRACTS FROM MOINIER'S TESTIMONY.

"Sixth. Before the 2d March, 1855, the date of your preliminary agreement with Mr. Tilghman, had you not seen at his laboratory in London the tubular coil apparatus described in his patent; and also specimens of

of fat acids and glycerine which had been made in said apparatus? (Rec. 87, p. 287.)

"To the sixth cross-interrogatory he saith: Without being able to state the exact date, I remember to have seen at London, in the logings of Mr. Tilghman, a little tubular apparatus, as well as small specimens of fatty bodies, and a little flask of glycerine, which I was told had been obtained by the patentee's method and by means of the little tubular apparatus. (Rec. 87, p. 298.)

"'LA VILLETTE, *4th March*, 1855.

"'Mr. DE FONTAINE MOREAU,

"'*Agent of R. A. Tilghman*,

"'39 *Rue de l'Echiquier*, *Paris*.

"'SIR: I have received the letter which you have done me the honor to write to me the 2d inst., and which the conditions upon which we offer to buy the absolute, general, and exclusive license for the new processes of Mr. Richard Albert Tilghman for the treatment of fatty and oily substances, principally applicable to the fabrication of soap, candles, tapers, and glycerine.

"'These conditions are, that we consent to pay annually for the aforesaid license, during all the rest of the time the patents have to run, a tax or royalty of fifteen francs for each thousand kilogrammes of fatty substance manufactured, two millions of kilogrammes being taken as the minimum to be manufactured in each year; and we consent also to pay the said tax of fifteen francs per thousand kilogrammes upon the minimum, even when the quantity per year manufactured by us shall be less that that above stated. The aforesaid tax shall be paid in two equal half-yearly payments.

"'We bind ourselves to construct, under the direction and advice of Mr. Tilghman, an apparatus similar to that described in the specification, and *after experiments shall have been made*, (to put us in a position to judge of the *efficacy* and the *reality* of the invention,) a contract shall be executed before a notary public, as required by law, and shall be signed by us and by R. A. Tilghman.

"'The respective parties shall be bound during one month from this date; at the expiration of this period, if the foregoing propositions are not accepted, the present arrangement shall be considered as null.

"'Accept, sir, my particular compliments.

("'Signed) MOINIER,

"'*One of the Manufacturing Parties of the firm, Jaillon, Moinier & Co.*'

(Rec. 87, p. 273.)

Between the 2d March, 1855, the date of your preliminary agreement,

and the 24th July, 1855, the date of your definite agreement with Mr. Tilghman, was not the said tubular apparatus brought to Paris and worked at your factory in your presence?

"To the seventh cross-interrogatory he saith: Yes; the little tubular apparatus was transported to Paris and placed in our factory, where Mr. Tilghman put it in operation in my presence."

"Tenth. Did not your firm, under your advice, on or about July 24, 1855, make a contract with Mr. Tilghman for a provisional purchase of his patent, under which contract the sum of fifteen thousand francs was paid to Mr. Tilghman?

"To the tenth cross-interrogatory he saith: It was not upon my own personal advice, but upon the incessant solicitation of Mr. de Fontaine Moreau, patent agent at Paris, in whom our firm had the greatest confidence, that the contract was made with Mr. Tilghman for the provisional and conditional purchase of his patent. I know that on that occasion Mr. Tilghman received a sum of money, but I do not recollect the amount of said payment. (p. 299.)

"Tenth. Will you state *whether said contract between you and Mr. Tilghman was annulled;* if yea, for what reason, by whom, and at what time and place? Have you any writings from Mr. Tilghman, or his agent, in relation to said contract or experiments; if yea, will you annex them to your answers hereto?

"To the tenth interrogatory he saith: The contract made between Mr. Tilghman and our firm was annulled by common consent, because the process never produced fat acids and glycerine. I am not able to produce the original of the first contract made with Mr. Tilghman, nor the papers annulling the same, as they were documents belonging to the firm; they remained in the archives of the firm, Moinier & Co., at present dissolved and its affairs settled." (p. 296.)

Then came Moinier letter, urging Tilghman not to have De Milly sued for infringement. (See p. 120.)

Moinier makes new agreement.

"Fourteenth. Did you, at any time after the discontinuance of said experiments, and after your said agreement with Mr. Tilghman was annulled, and at what time, renew any negotiations with him, or make any new contract with him; if yea, will you state at what time you did so, through whose intervention, and on what grounds, and how you were induced to renew any attempts in relation to said matters?

Did you make any agreement on the subject? Was it in writing; if yea, will you annex it, or a correct copy? With whom was it made? Was M. Fontaine Moreau Mr. Tilghman's agent? How do you know this? If the agreement was verbal, will you state the particulars of it? Were there, or not, any, and what, changes introduced by Mr. Tilghman on his said method and apparatus? Please describe them, if any?

"To the fourteenth interrogatory he saith: Some time after the first experiments were discontinued and the first contract annulled with Mr. Tilghman, Mr. de Fontaine Moreau, in whom we had great confidence, announced to us the return to Europe of Mr. Tilghman with a new process, based upon the principles of the method already patented, and urged us earnestly, and decided the firm, much to my regret, I assure you, to join the firm of Charles Leroy & Durand, candle manufacturers at Paris, to whom he had already spoken for the trial of the new process, the success of which he said was certain, as Mr. Tilghman had already obtained admirable results in the United States. A new contract was made between Mr. Tilghman and my firm, representing also Mr. Charles Leroy & Durand, upon the same basis as the first, Mr. de Fontaine Moreau again representing Mr. Tilghman, the patentee. (p. 297.)

"Fifteenth. Were any experiments made under this new agreement? If yea, under whose direction? Were they under the patent of Mr. Tilghman of 1854, or in what respect, if any, did they vary from it? What were the changes, if any, from the former plans?

"To the fifteenth interrogatory he saith: These experiments were made by the younger Mr. Tilghman, in conformity with the patent of 1854, for the principals, and with the new improvement brought to the method by the patentee, but they were not more successful than the first. (p. 297.)

"Sixteenth. What was the result of these last experiments? On what apparatus were they conducted? Were the experiments successful? If not, will you state why they did not succeed? What was the product? At what cost or expense were the experiments made, and how long were they continued, and at what place? Explain fully.

"To the sixteenth interrogatory he saith: These experiments were made in and with the apparatus already described. As to the reason and cause of the failure, I have nothing more to say than I have already said in regard to the experiments made by virtue of the first contract. I do not remember

how much these last experiments cost us. I only remember that before they were commenced Mr. Tilghman caused to be paid to himself a considerable sum of money, twelve or fifteen thousand (12,000 or 15,000) francs, which Mr. de Fontaine Moreau, agent of patentee, required of Mr. Charles Leroy & Durand, and that I did wrong in consenting to it. (p. 297.)

"[Imperial stamp.]

"According to summons of Marecat, (Charles,) bailiff ('huissier') of civil tribunal of first instance of the Department of the Seine, sitting in Paris, and residing 'Boulevart de Sebastopol, No. 46.'

"The plaintiff summoned the defendant to appear on Thursday next, 17th November, at the court-room, and before the tribunal, in order that—

"Whereas, by *verbal agreements*, in date of the 13th of September, 1858, Mr. Fontaine Moreau, acting for and in behalf and for the account of Mr. Tilghman, declared that this latter was the owner of patents of, &c., &c. * * *

Said agreement was in writing, and copy in full given. (Rec. 87, p. 311.)

"Now, therefore, considering that no opposition is made to the claims of the plaintiffs, and that the same have been satisfactorily proven; for these reasons, rendering judgment in the first instance, declares null and void the agreements in question, and condemns the defendant by all legal means, and even by bodily constraint, according to the laws of April 17, 1832, and December 13, 1848, to pay to the plaintiffs 2,000 francs, to which sum they have, for the present, declared their claim for indemnity to be reduced." (Rec. 87, p. 300.)

Tilghman, having heard of this, appealed.

And the results are—

"The following has been determined and agreed upon:

"ARTICLE 1ST. By these presents the parties annul all treaty and agreements existing in any form between them, and especially the contract of September 13, 1858.

"ARTICLE 2D. The law-suit existing between the parties, and from which *Mr. Fontaine Moreau has made appeal*, shall no longer continue, and shall cease.

"ARTICLE 3D. Messrs. Moinier & Co., and Messrs. Charles Leroy & Durand, shall pay to Mr. Fontaine Moreau the sum

of five hundred francs each, or together *the sum of one thousand francs, as compromise* of said law-suit.

"ARTICLE 4TH. Each of the parties shall pay its own expenses with reference to said suit.

"ARTICLE 5TH. Mr. Richard Albert Tilghman shall reenter into the free use and enjoyment of his patents.

"In consequence, all engagements taken are null and of no effect, both those affecting said Mr. Tilghman as those affecting Messrs. Moinier & Co., and Messrs. Charles Leroy & Durand, the parties meaning by means of this compromise to renounce all claim whatever and on any ground whatever." (Rec. 87, p. 319.)

TABLE OF PRESSURES AND TEMPERATURES.

(Record No. 340, p. 200.)

Q. 22. Please give a table from the best authorities, of the temperatures corresponding to different pressures up to 300 pounds per square inch.

Pressure in lbs.	Degrees Fahrenheit.	Pressure in lbs.	Degrees Fahrenheit.
0	212°	165	374°
15	250°	180	380°
30	275°	195	386°
45	293°	210	392°
60	308°	225	398°
75	320°	240	403°
90	331°	255	408°
105	341°	270	413°
120	350°	285	418°
135	358°	300	422°
150	367°		

Continuation from the text-writers.

lbs.	Degrees.	lbs.	Degrees.
315	427°	510	472°
330	431°	585	486°
345	435°	660	491°
360	439°	735	510°
435	457°		

CALCULATION

Of the Quantity and Value of the Lime, Sulphuric Acid, and Fat Saved by Appellant, from December, 1860, to January 9, 1868.

[The quantities worked and prices are taken from appellant's own evidence. (Record No. 87, pp. 253, 254, 265 to 267.) The saving is calculated at 13½ lbs. lime, and 27 lbs. sulphuric acid, and 2 lbs. fat upon each 100 lbs. of fat worked.]

DATE.	Fat worked.	Lime saved, 13½ per cent.	Price of lime per bbl.—215 lbs.	Price lime per lb.	Value of lime saved.	Sulphuric acid saved, 27 per ct.	Price acid per lb.	Value acid saved.	Fat saved, 2 per ct.	Price of fat, half tallow, half lard.	Value fat saved.
	lbs.	lbs.		cts.		lbs.	cts.			cts.	
December, 1860.....	166,535	22,482	$1.05	.488	$109.71	44,964	2	$899.28	3330	9¼	$288.52
January, 1861.....	"	"	1.00	.465	104.54	"	2	899.28	"	9.62	301.75
February, "	"	"	1.00	.465	104.54	"	2	899.28	"	9¾	306.16
March, "	"	"	1.10	.511	114.88	"	2	899.28	"	9½	297.34
April, "	"	"	1.10	.511	114.88		2	899.28	"	9½	297.34
May, "	"	"	.90	.418	93.97	"	1.95	876.79	"	8¾	270.88
June. "	"	"	.90	.418	93.97	"	1.90	854.31	"	8¾	270.88
					$736.49			$6227.50			2032.87
											6227.50
											736.49
In the year ending July 1, 1861, total value of lime, acid, and fat saved.....											$8,996.86
October, 1861.....	187,789	25,351	$ .85	.375	$ 95.06	50.702	1.8	$912 63	3735	8⅞	$333.24
November, "	"	"	.85	.375	95.06	"	1.8	912.63	"	8⅞	333.24
December, "	"	"	.80	.372	94.30	"	1.8	912.63	"	9	337.95
January, 1862.....	"	"	.85	.375	95.06	"	2	1014.04	"	8¾	328.55
February, "	"	"	.80	.372	94.30	"	1.95	988.88	"	8½	319.17
March, "	"	"	.80	.372	94.30	"	2	1014.04	"	8½	319.17
April, "	"	"	.80	.372	94.30	"	2	1014.04	"	7¾	291.00
May, "	"	"	.90	.418	105.96	"	1.9	963.33	"	8	300.40
					$768.34			$7732.22			2562.72
											7732.22
											768.34
In year ending July 1, 1862, total value of lime, acid, and fat saved.....											$11,063.28
September, 1862.....	175.071	23,634	$ .90	.418	$ 98.79	47.266	2	$945.36	3501	10½	$376.60
October, "	"	"	.90	.418	98.79	"	2	945.36	"	10½	376.60
November, "	"	"	1.00	.465	109.89	"	1.95	921.72	"	10⅞	380.72
December, "	"	"	1.00	.465	109.89	"	2	945.36	"	10¼	358.85
January, 1863.....	"	"	1·00	.465	109.89	"	2¼	1033 53	"	10½	376.60
February "	"	"	1.00	.511	120.76	"	2¼	1033.53	"	10½	376.60
					648.01			5824.86			2245.97
											5824.86
											648.01
In year ending July 1, 1863, total value of lime, acid, and fat saved.....											$8,718.84

Date.	Fat worked.	Lime saved, 13⅓ saved.	Price of lime per bbl.—215 lbs.	Price lime per lb.	Value of lime saved.	Sulphuric acid saved.	Price acid per lb.	Value acid saved.	Fat saved, 2 per ct	Price of fat, half tallow, half lard.	Value fat saved.
	lbs.	lbs.		cts.		lbs.	cts.		lbs.	cts.	
September, 1863.....	155,015	20.927	$1.20	.558	$116.77	41,854	2½	$941.71	3100	15	$465.00
October, "	"	"	1.35	.628	131.42	"	2¼	941.71	"	14	434.00
November, "	"	"	1.45	.674	141.04	"	2½	1045.35	"	14	434.00
December, "	"	"	1.60	.744	155.69	"	2½	1045.35	"	14¾	457.25
January, 1864.....	"	"	1.60	.744	155.69	"	2½	1055.36	"	11⅝	360.37
February, "	"	"	1.60	.744	155.69	"	2½	1045.36	"	11½	356.50
March, "	"	"	1.60	.744	155.69	"	2⅝	1098.66	"	12⅜	383.62
April, "	"	"	1.60	.744	155.69	"	2¾	1150.98	"	12	372.00
May, "	"	"	1.65	.767	160.51	"	3	1255.62	"	12¾	395.25
					$1328.19			$9570.08			3657.99
											9570.08
											1328.19
In year ending July 1, 1864, total value of lime, acid, and fat saved.....											$14,556.26
September, 1864.....	199,305	26,906	1.60	.744	200.18	53,812	5	2690.60	3986	19¼	767.30
October, "	"	"	1.60	.744	200.18	"	5	2690.60	"	17⅝	707.51
November, "	"	"	1.60	.744	200.18	"	5	2690.60	"	17⅝	707.51
December, "	"	"	1.70	.790	212.55	"	5	2690.60	"	18	717.47
January, 1865.....	"	"	2.00	.930	250.22	"	5	2690.60	"	17½	697.55
February, "	"	"	2.00	.930	250.22	"	5	2690 60	"	17⅝	707.51
March, "	"	"	2.00	.930	250.22	"	4½	2421.54	"	18	717.47
April, "	"	"	1.90	.883	237.57	"	4⅜	2354.27	"	14	558.04
May, "	"	"	1.75	.813	218.74	"	4	2152.48	"	17	677.62
June, "	"	"	1.55	.720	193.72	"	3⅝	1951.68	"	12½	498.25
					$2213.78			25,023.57			6,756.23
											25,023.57
											2,213.78
In year ending July 1, 1865, total value of lime, acid, and fat saved.....											$33,993.58
October, 1865.....	179,251	24,198	2.15	1 00	241.98	48,396	4	1935.84	3585	15½	555.67
November, "	"	"	2.40	1.11	268.59	"	4¾	2298.71	"	14⅝	528.78
December, "	"	"	2.40	1.11	268.59	"	5	2419.80	"	14	501.90
January, 1866.....	"	"	2.40	1.11	268.59	"	5	2419.80	"	14½	519.82
February, "	"	"	2.40	1.11	268.59	"	5	2419.80	"	13	476.05
March, "	"	"	2.35	1.09	263.75	"	4⅞	2359.20	"	13	476.05
April, "	"	"	2.15	1.00	241.98	"	4	1935.84	"	11½	412.27
May, "	"	"	1.90	.883	213.66	"	4	1935.84	"	11⅞	425.71
June, "	"	"	1.90	.883	213.66	"	4	1935.84	"	12½	448.12
					$2249.39			19,660.67			4,344.37
											19,660.67
											2,249.39
In year ending July 1, 1866, total value of lime, acid, and fat saved.....											$26,254.43
October, 1866.....	222,351	30,017	2.00	.930	279.15	60,034	4½	2701.53	4447	12⅜	550.30
November, "	"	"	2.00	.930	279.15	"	4½	2701.53	"	12⅜	550.30
December, "	"	"	2.00	.930	279.15	"	4½	2701.53	"	12⅜	550.30
January, 1867.....	"	"	2.00	.930	279.15	"	4½	2701.53	"	12	533.64
February, "	"	"	2.00	.930	279.15	"	4	2401.36	"	10¾	478.04
March, "	"	"	2.10	.976	292.96	"	3½	2101.19	"	11½	511.40
April, "	"	"	2.10	.976	292.96	"	3⅜	2026.14	"	10¾	478.04
May, "	"	"	1.87	.870	261.14	"	3⅜	2026.14	"	10⅞	483.59
June, "	"	"	1.60	.744	223.32	"	3⅛	1876.06	"	11⅜	505.83
					$2466.13			21,237.01			4,641.44
											21,237.01
											2,466.13
In year ending July 1, 1867, total value of lime, acid, and fat saved.....											$28,344.58

Date.	Fat worked.	Lime saved, 13½ per cent.	Price of lime per bbl.—215 lbs.	Price lime per lb.	Value of lime saved.	Sulphuric acid saved	Price acid per lb.	Value acid saved.	Fat saved 2 per ct.	Price of fat, half tallow, half lard.	Value fat saved.
	lbs.	lbs.		cts.		lbs.	cts.		lbs.	cts.	
September, 1867.....	104,541	13,590	$1.57	.730	$99.20	27,180	3	$815.40	2090	11	$229.90
October, "	209,082	27,180	1.75	.813	220.97	54,360	3	1630.80	4181	12⅜	515.39
November, "	209,082	"	1.75	.813	220.97	"	2¾	1344.90	"	12⅛	504.94
December, "	209,082	"	1.85	.860	233.74	"	2½	1259.00	"	12⅛	504.94
January, 1868.....	50,000	6,750	1.85	.860	58.05	13,500	2½	837.50	1000	12⅛	121.25
					$832.93			$5387.60			$1876.42
											5387.60
											832.93
From Sept. 1, 1867, to Jan. 9, 1868, total value of lime, acid, and fat saved.....											$8096.95

CALCULATION

Of Profits from the Glycerine produced by Appellant.
(Rec. 87, pp. 253, 254, 265 to 267.)

Date.	Glycerine sold.	Price per lb.	Amount received.	Quantity of fat worked.	Profit 1-5 ct. per lb. of fat worked.	Int. to Jan. 1, 1869.		
	lbs.	cts.		lbs.		Yr.	p ct	
1862	47,120	10	$4,712.00					
	12,684	10½	1,331.82	1,502,316	$3,004.63	7	.49	$1471.96
1863	45,593	10½	4,787.26					
	25,061	11	2,756.71	1,050,426	2,100.85	6	42	882.00
1864	148,456	11	16,330.16	1,395,142	2,790.28	5	35	1276.50
1865	133,895	11	14,728.45					
	3,635	15	545.25	1,993,051	3,986.10	4	28	1116.08
1866	9,036	15	1,355.40					
	32,439	14	4,541.46					
	34,518	13	4,487.34					
	18,595	13½	2,510.32					
	35,074	14	4,910.36	1,613,263	3,226.52	3	21	677.46
1867	162,627	22	35,777.94	2,782,949	5,565.89	1	7	389.55
	708,733		$98,774.47	10,337,147	$20,674.27			$5813.55

RECAPITULATION.

In year ending	Quantity of fat worked.	Value lime, acid, & fat saved.	Interest to Jan. 1, 1869.		
	lbs.		Years.	per ct.	
July, 1861	1,165,745	$8,996.86	7½	52½	$4,724.47
" 1862	1,502,316	11,063.28	6½	45½	5,033.66
" 1863	1,051,426	8,718.84	5½	38½	3,356.43
" 1864	1,395,142	14,556.26	4½	31½	4,585.14
" 1865	1,993,051	33,993.58	3½	24½	8,328.28
" 1866	1,613,263	26,254.43	2½	17½	4,594.45
" 1867	2,001,162	28,344.58	1½	10½	2,976.17
January 9, 1868	781,787	8,096.95	1	7	566.72
	11,502,892	$140,024.78			$34,165.32

Lime saved	1,552,889 lbs.	Value	$11,243.26	
Acid saved	3,105.778 "	"	100,663.51	
Fat saved	230,057 "	"	28,118.01	
			$140,024.78	$140,024.78
Interest to Jan. 1, 1869				34,165.32
Glycerine sold, 708,733 lbs.				
Amount received, $98,744.47.				
Produced from 10,337,147 lbs. fat worked.				
Profit 1-5 cent per lb. of fat worked, $20,674.27				20,674.27
Interest to Jan. 1, 1869				5,813.55
				$200,577.92

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